

October 8, 1962

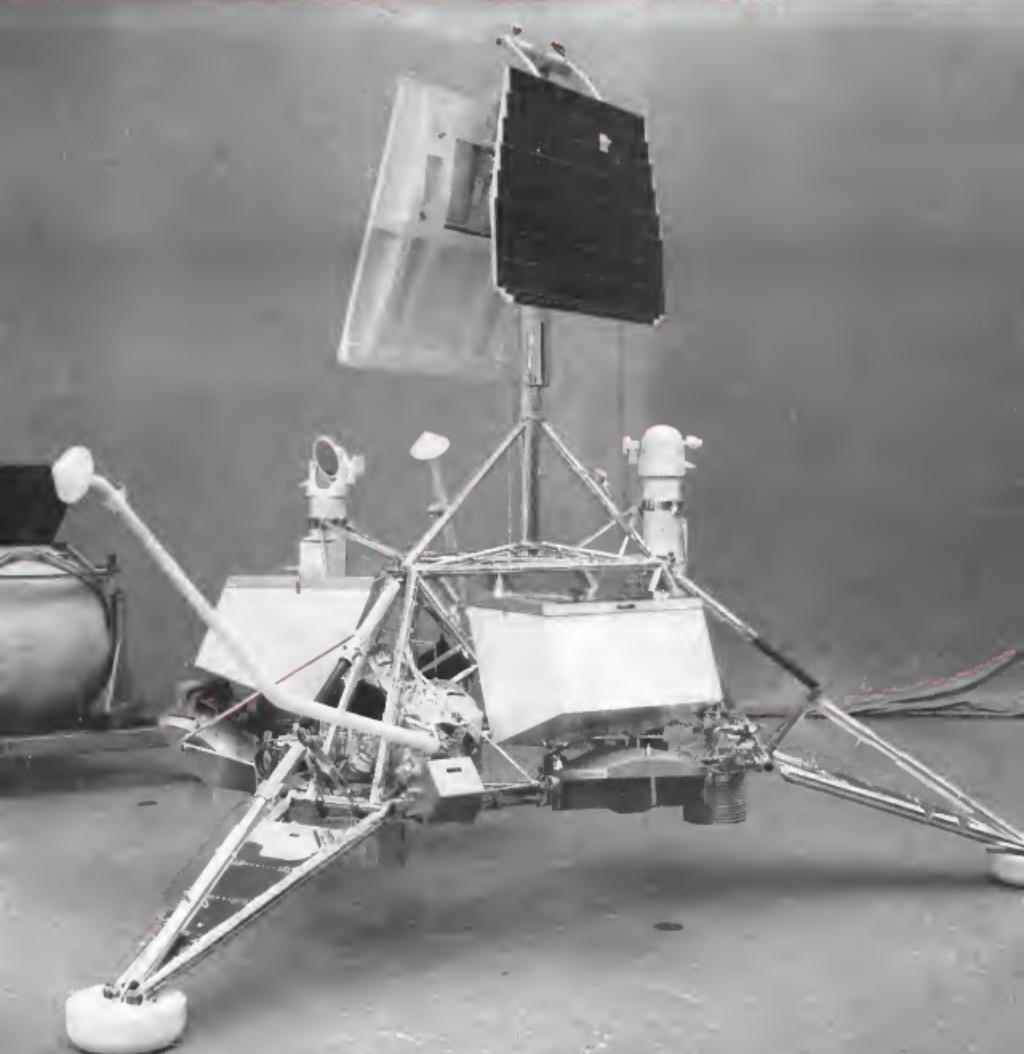
# Aviation Week & Space Technology

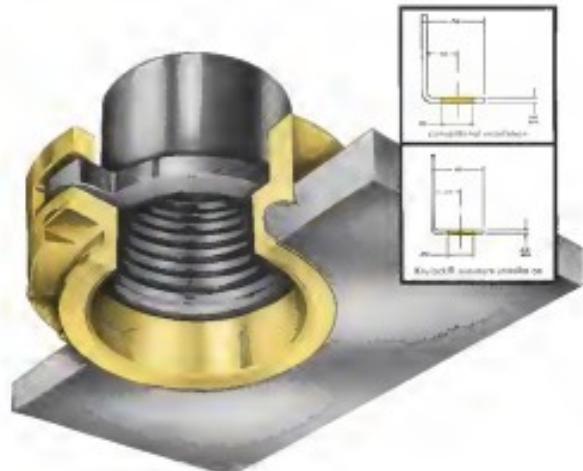
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Needs, Scope  
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[not a lightning bolt]

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MK 7000 Floating washer



MK 2200 non-floating washer



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Magnetic Products Division **3M**

AEROSPACE CALENDAR

- Oct 9-11—North Astron Al Atoms Sci and Engineering Symposium, Sandia AFB, San Antonio, Tex Sponsored by Air Force Systems Command, Office of Space Research

Oct 9-11—National Acoustics Conference, sponsored by Acoustics Conference, University of California, Berkeley, Calif Oct 12-13—Int'l on Plasma & Rocket Dynamics Conference, American Rocket Society, Palm Springs, Calif

Oct 13-15—19th Annual Aerospace Electronics Symposium, Post-Publication, Los Angeles, Calif

Oct 13-15—Industries in Photography at Military Displays, Sheraton Hotel, Washington, D.C. Sponsored by Society of Photographic Artists & Engineers, Inc., Washington, D.C.

Oct 15-17—Fall Meeting, International Society for Radio Union & Institute of Radio Engineers, Ottawa, Canada

Oct 15-17—NIST Meeting, Sonnenberg Hotel, Bonner, Man. Sponsored by NIST, U.S. Navy (Contractor Support)

Oct 15-19—International Symposium on Space Photoionization and Micrometeorites, Statler Hilton, Detroit, Mich. North American Meeting, NASA, AGU

Oct 15-19—17th Annual Instrumentation Association Conference on Industrial Instrumentation, Atlantic City, N.J., and New York, New York, N.Y.

Oct 16-20—Symposium on Liquid Metal Reactor Technology, AT&T M.L. Sperry

(Continued on page 7)

(Continued on page 7)

AVIATION MILITARY and Space Technology

October 8, 1993  
Vol. 22 No. 35

Vol. 27, No. 15

Problems. These will form the basis of the discussion.



Now from G.E. 116-page 5-Star tube booklet tells...

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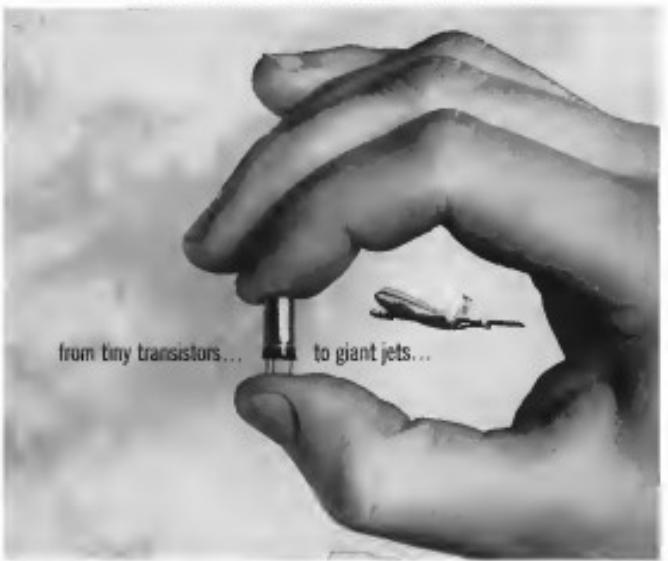
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### AEROSPACE CALENDAR

[Continued from page 5]

Oct. 16-18—Rocketdyne Division of Lockheed Corporation Seminar on Noise in Electrical Systems, Malibu Tower Hotel, Los Angeles, N. S.

Oct. 18-19—Second National Conference on Flying and Dragging Under Helicopter Facilities, Institute of Aerospace Sciences Bldg., Los Angeles, Calif. Sponsored Los Angeles Chapter of Composites.

Oct. 18-19—Sixth Annual Display, Aerospace Electronic Society, San Diego, Calif.

Oct. 19-20—Joint Meeting, Canadian Association of Engineers, Royal Edward Sherman Hotel, Toronto, Canada.

Oct. 23-24—East Coast Conference on Aerospace and Navigation Electronics, Institute of Radio Engineers, Eastern Hotel, Boston, Mass.

Oct. 23-24—Annual Meeting, National Army Aviation Assn., Studio Hilton Hotel, Washington, D. C.

Oct. 24—International Meeting & Exposition Society for Experimental Stress Analysis, Hotel Scherzer, Milwaukee, Wis.

Oct. 25-27—1962 Electron Device Meeting, University of Illinois, Urbana, Sherman Park Hotel, Waukegan, Ill. D. C.

Oct. 25-26—1962 Midway Quality Control Conference, American Society for Quality Control, Deacon Hilton Hotel, Denver.

Oct. 26-27—Fourth Annual Western Technical Conference, American Institute of Electrical Engineers, Sherman Hotel, Los Angeles, Calif.

Oct. 29-30—Aerospace Plant Power Conference, Fair Park Statley Hotel, Detroit, Mich. Sponsored Aerospace Division, Detroit, Mich.

Oct. 29-30—Meeting of Latin American, El Dorado Inn, Barranquilla, Colombia.

Oct. 29-30—Symposium on Dynamics of Mixed Living Polymer Easys, Philadelphia, Pa. Sponsored jointly by the Radiation Research Assn., M. S. Gory Co., Gossen Electric Co., IBM, Velox Corp., Space Technology Center, Inc., EG&G, Philadelph. 1, Pa. Co-sponsored AFOSR.

Oct. 29 Nov. 2—World Metal Show & Meeting, Metal Congress America Society, New York City, N. Y.

Oct. 29-Nov. 4—International Symposium, "Basic Environmental Problems of Man in Space," UNESCO House, Paris, France. Sponsored International Organization for Standardization, International Association of Scientific and Technical Committees.

Oct. 30—Westcoast Commercial Transport Vehicle Inspection, Manufacturing Society, Studio Hilton Hotel, New York, N. Y.

Oct. 30-Nov. 1—National Conference on Space Power Components Engineering, IBM, De Anza Hotel, Andover, Calif.

Oct. 30-Nov. 1—Meeting of the Space and Defense Agency Research Foundation, Chicago, Ill. Sponsored U. S. Army, Navy, Air Force.

Nov. 1—Annual Meeting, General Aviation Safety Committee, National Safety Council, Conrad Hilton Hotel, Chicago, Ill. [Continued on page 9]

### COOL HEADS for HOT SPOTS



(Dr. The Stirling Saga of Sutter Hexafluoride Subdues)

Over coffee one recent morning (our meetings always go right on thinking during coffee breaks), we observed one of the stirring froths of our Environmental Control Systems Department wearing a grin that can be described only as Cheshire. Ignoring previous experience under the tutelage of present company, we inquired of the source of his grin.

Seems that the dielectric properties of air isn't good enough for it to be used as a pressurization gas for many of the high-pressure wing-ground service items used today. The best air, at 50 psi—a gas that costs 2 to 3 times the discharge strength of air at normal pressure, and even more at higher pressure,

Ah, but there's a rub (that is, those two are a rub): If you want to depend on air, you have to keep it pure. Among or current discharges decomposes the gas, and the decomposition products would eat the insulation off your favorite tree. The gas must be constantly re-circulated to remove these corrosive products. And moisture, another troubleshaker, must also be eliminated.

Enter the hero: Kazuo Nagai will be burdened to honor to uphold (Bald) Electronics has not yet developed cooling equipment to air and moisture-free purity of SF<sub>6</sub> gas for navigation; he left his group to glory in missile terms, they designed and perfected the Bald Model PHS-3000 system. Deceptively simple in appearance, this system stores the SF<sub>6</sub>, auto-

matically regulates supply, compensating for normal leakage at the waveguides... and maintains both required purity and dryness. Its recirculation system (concentrically nested) delivers reliable, contaminant-free operation and long service.

At this point, our air manager thinks we should remind you that our Environmental Control Systems Department didn't get SF<sub>6</sub> handling by accident: We've been designing and manufacturing heat exchangers, air-cooled condensers and oil-cooling systems and electronic distributors for electronic equipment for over 20 years. If you've got an equipment or tube cooling problem... space, ground or sea... or an operating gas problem with waveguides, cavities, rotary parts, coaxial lines or similar components, it's a sure bet you should know about our current activities. Write Environmental Control Systems, Bald Electronics, 43-22 Queens St., Long Island City 1, N. Y.

\*TAD = transverse air distribution.

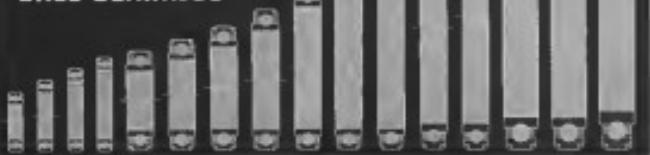
Bald Model PHS-3000 SF<sub>6</sub> Handling System

**Bald** ELECTRONICS  
A DIVISION OF THE EEDO COMPANY, INC.  
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Air Spacings - Parts Business  
Environmental Control Systems  
Test Facilities Engineering



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- Standard availability in 440C stainless or 50100 steel ... special materials to order.



**TCR**, patented SBB construction, without loading slots or counterbores, utilizes maximum ball complement with one-piece reinforced phenolic retainer, for maximum load capacity. Up to 62% greater load and 300% greater life potential than affected by conventional Caged design. Also features low torque and high starting reliability. Available with biplane retainer as type TCR, or otherwise retainer, type TCR.



**TCF, TCA**, patented SBB construction permits utilizing full ball complement without incorporating loading slots or counterbores, for heavy loads and relatively low speeds. Type TCA is same as Type TCF, except alternate balls are tendency to function as ball carriers, for moderate loads and speeds.



**TWF, TWA**, patented SBB construction, internally similar to Types TCF and TCA, except high employ unique integral shield design, which with caged clearance annulus and greater load-carrying functions virtually as axial Type TWF with full ball complement, and Type TWA with wear-wear balls slightly undersized.



**TAR**, Angular contact design with one-piece reinforced phenolic retainer, for combination radial and high thrust loads. Also available as Type TAR with one-piece stamped stainless steel retainer.



**TKR**, Conventional Caged design with one-piece snap-type reinforced phenolic retainer - capacity was less than Type TCR patented SBB construction, but adequate for relay armature applications at lower cost. Also available with Tolloc slug ball spacer as type TBL, or with spring separators as type TRP.

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# SBB

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miles  
HIGH

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TV picture of the surface of Echo II, inserted a functioning 200-mile-high TV transmitter in the space station, is shown at a controls station of Rockwell International TV camera. From its position in the Thor booster rocket, the camera faced "live" the satellite's collapse. The pictures are considered to be the first ever obtained in "real-time" from space and are considered to be the best ever taken in outer space. As a result they may revolutionize scientific writing.

The TV camera, an 18" long and 214" in diameter, was designed around the RCA-8134 - an electronically focused, magnetically-deflected Vidicon uniquely adapted to transmitted camera design. With focus and astigmatism, the Vidicons ensure very extremely lightweight and compact - ideal features for space robotic equipment!



For earth-bound applications, the RCA-8134 is well-suited for infrared or closed circuit TV. It requires no deflection geometry, no lenses, and low power requirements are met. The tube features a phosphor-coated cathode, magnetic-beam control, focus, and ultra minimum sensitivity and speed of response.

Where your requirements include compact, lightweight, monochrome TV cameras design, consider the RCA-8134. For a technical brochure, write to: G. J. Clegg, Director, RCA Electron Tube Division, Wayne, N. J.

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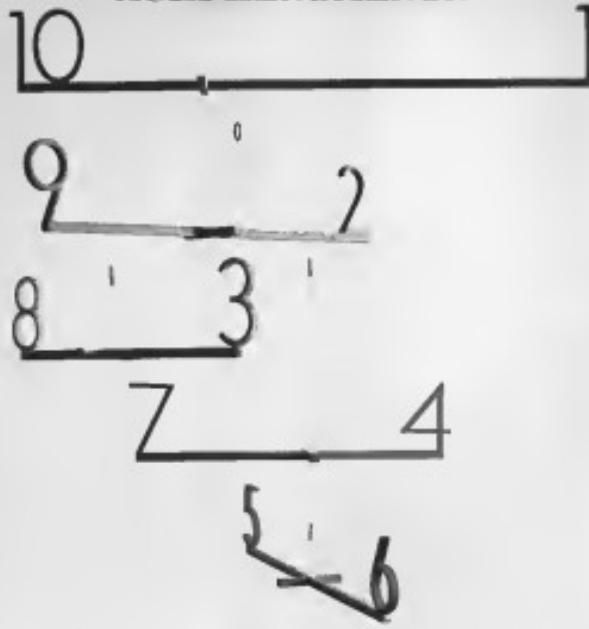
SELTZER TABLETS, GLASS OF WATER, UNHAPPY, YOU HAVE AN HURT LIQUID, INK THEM, YOU HAVE IMMEDIATE REACTION. WHAT DOES THIS SIMPLE THERAPEUTIC SYSTEM HAVE IN COMMON WITH UTC ROCKET PROPULSION DEVELOPMENT? UNITED TECHNOLOGY CORPORATION IS WELL ALONG WITH A DEVELOPMENTAL HYBRID ROCKET MOTOR, IN WHICH A LIQUID OXIDIZER IS BROUGHT INTO CONTACT WITH SOLID FUEL. THE RESULT IS A WHOLLY NEW KIND OF PROPULSION SYSTEM. COMBINING TRADITIONAL SOLID PROPELLANT RELIABILITY WITH THE HIGH PERFORMANCE FIGURES CHARACTERISTIC OF LIQUID ENGINES, UTC'S HYBRID OFFERS UNLIMITED START-AND-STOP CAPABILITY, AND HIGHER SPECIFIC IMPULSE THAN ANY OTHER NON-DRYOGENIC SYSTEM. APPLICATIONS: MOLE BOOSTERS, SOFT LUNAR LANDINGS, ORBITAL CHARGES OF SPACECRAFT, CONTROLLABLE BALLISTIC MISSILES. ANOTHER STATE-OF-THE-ART ROCKET DEVELOPMENT BY UTC.



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## ACHPHENOMENON



Shortcut to a sum. The discoverer Karl Friedrich Gauss, age six. Call it Cognitive Reorganization, Insight, Achphenomenon. It's that click that snaps ten separate numbers into five pairs, each totaling eleven. The flash that puts the parts into a whole. The new direction that yields more elegant methods of solution.

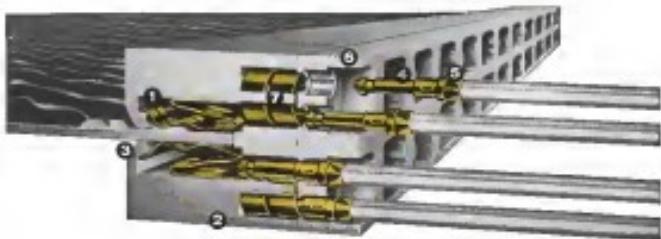
Advances in Litton Systems are being made by engineers with impulses to ignore ceilings and break barriers. If you are impelled to turn your fleshes into feels, act now. Send your resume to Mr. Don A. Kraus, Manager Professional and Scientific Staffing. You may expect prompt attention.



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③ closed entry face protects springs, self-align warped boards

④ wide contact tips (straight shank) and board have multi-point contact surfaces, independent contact locking action

⑤ gold plated, spring type, insulation grip

take single or multiple leads

⑥ closed entry on wire lead side prevents shorting

⑦ 1 or 2 wire leads for each board position on each side. Additional features available in 3 sizes—15, 22, and 43 positions; low board insertion and withdrawal forces; dry circuit as well as power applications; mounting clips and jumpers available for joining circuits; polarizing key available without loss of any contact position for pre-terminated or unshielded boards. Meets applicable military specifications

*Bandwidth available installation makes installed costs lower than less reliable connectors.*

**BURNDY**  
Burndy Connectors



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AMPEX FR-800

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ments. You can mount the FR 800 in a submarine. Use it for radar reconnaissance, radar tracking, fire detection, communication monitoring—any application covering the frequency range of 10 cps to 4 Mc! You'll find it convenient to operate. Want more data? Write the only company providing recorders, tape and memory devices for every application. Amplex Corporation, 934 Charter St., Redwood City, Calif. Worldwide sales and service.

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# Aviation Week & Space Technology

October 8, 1984

Volume 22  
Number 18

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## EDITORIAL

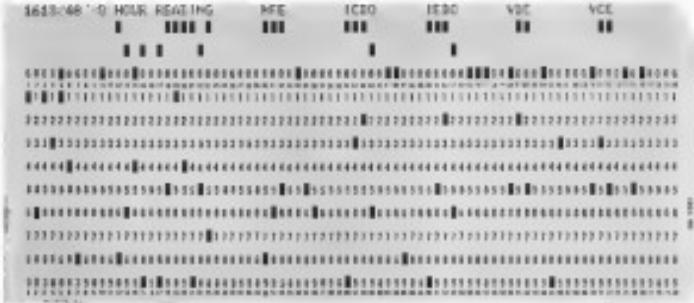
- SPUTNIK TO SCHIRRA** . . . . . 21

- GOALS:** Engineering mockup of the Surveyor lower soft-landing spacecraft. Top: View located at Calver City, Calif., by the systems contractor, Hughes Aircraft Co. Seven space craft will be built by Hughes as part of National Aeronautics and Space Administration's unmanned lunar exploration program. For further details and photographs, see p. 78

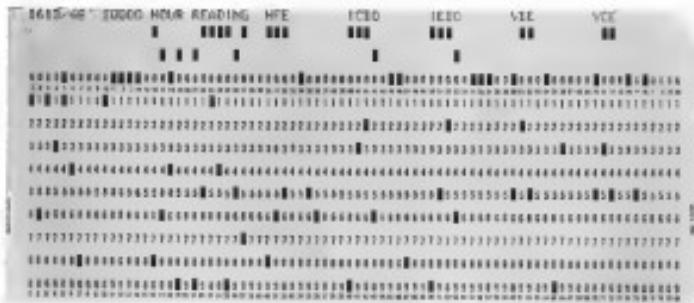
## FEATURE OPINION

- Aviation Week**, October 8, 1984 • 29 • \$1.00 • International 29 • 40c • Postage 10c  
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Here are the electrical test results of a brand new Fairchild transistor recorded on an IBM card:



Here are the results of the same test on the same transistor—after 10,000 hours in use:



No change. That's progress.



EDITORIAL

Sputnik to Schirra

The space age celebrated its fifth birthday last week. The interval between the first orbit at the Soviet Sputnik I and the final 9½ flight of Capt. Walter Schirra Jr., in his Sigma 7 Mercury capsule, may not be as long as five years. During that period space technology has made astonishing progress, although it is still as elusive technically as well as chronologically. Nine men have survived space flight, seven of them orbital entries. Telstar is carrying international television programs. There is mapping the world's weather. Earth has photographed the dark side of the moon. Manned space training now fills knowledge to Venus and some of space probes of many possibilities have added immeasurably to man's knowledge of his universe (use p. 56).

How many of even the most space-oriented Spanish predictions have already come true? How much of the supposedly "practical satellite" critics' position has been proved false since science and industry were last lectured on space technology? And how close the moon looks now with Soviet and US rocket technology improved by it and two powerful national defense pull-thoughs in their last two years on the寰球舞台. That's decided.

the launching of Vomol, it was caused not only by the difficulty of solving the reindustrialization problem experienced by Tito but also by the need to broaden the whole scope of their biostatistics program, including new methodology and instrumentation to gather data on the problems that lie ahead for prolonged hitchhiking of man in space.

The methods including both physical training of the Soviet communists and practice in fitting their vestibular system to cope with the disorienting effects of weightlessness, that proved successful for Communists Nikolayev and Popov were both ingenious. It must have been quite a sight to see those rough fighter pilots executing killer paroxysms for vestibular system exercise in microgravity. Fig. 6c, D-10.

It is also evident that both Vostok 3 and 4 carried a wide variety of biological specimens in addition to the entomofauna and that the two men were required to perform experimental work in biometeorology in spare time.

The Soviet priority on man in space may have several implications, but its military significance is obvious. Even Soviet official commentators are no longer reluctant to make this clear.

Cdr. Seltzer's superb flight in Sigma 7 was a good measure of how well the U.S. astronautics program progressed once it received some official support and solid funding. The Mercury program has built a tremendous foundation for future U.S. manned space efforts but it has been hampered by its late start and the booster limitations of the man-rated Atlas, although that vehicle has logged a remarkable reliability record in the Mercury injections.

#### Soviet Bioprosthetic Lead

Man in space is still the key to masters of space, although a broad program of scientific exploration is necessary to provide a firm technical foundation for man's long-term use of space. The Soviet program has been oriented from its inception toward adding space to man's material environment. The United States' program, in contrast, was conceived of as primarily a pure science venture with man entering it as a somewhat reluctant afterthought. That it is not surprising that while this country has yielded its space technology with a wide variety of unclaimed scientific achievements such as Tamm, Lebedev and Smirnov, the Soviets still enjoy a substantial lead in manned space achievements, and in the unearthing necessary to support that effort, such as bioastronautics. The Soviet superiority in rocket boosters, enabling them to put massive space capsules at least twice as heavy as Mercury into orbit, has been fully acknowledged by U.S. experts. But the Soviet lead in bioastronautics is probably even greater than in boosters and the U.S. should take advantage to close this gap.

Therefore, their concern with the problems of weight loss in a space environment even after the successful 14-day flight of Maj. Nikolayev in Vostok 3 and the three-day orbit of Lt. Col. Popovich in Vostok 4 is of real significance [see p. 38]. Recent papers delivered by Vassil Penev and V. I. Yudovskiy in Leyden, Holland, and Vienna, Bulgaria, make it clear that the weight loss interval between the flights of Maj. Titov in Vostok 2 and

## **II. 5.-Soviet Effects Contested**

One prediction by which the relative progress of the U.S. and USSR manned space programs may be measured is the fact that at the end of the Mercury program next year the final 24-hr. mission will only equal the performance over a one day of Mst. Titov in Vostok 2.

We still trail in the race and will continue to do so for another several years. But this is largely the race to develop fast or soft funding for our own financed program. It is the time to press on at maximum possible pace, to end as many bureaucratic obstacles as possible, and to utilize our technology to the fullest. These, slowly at first, but faster as the finish line comes closer, we may overtake the Soviets and put us in the race to the moon but also in the broader goal of controlling space for peaceful purposes and denying it to anybody who wants to use it to impose his will on the world.

—Robert Frost

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## WHO'S WHERE

### In the Front Office

Walter L. Monroe, R. president, Monson Diesel Corp., 100 East 57th St., New York City, N.Y. 10022; succeeded Joseph A. Shubert, deceased.

John C. Barnes, vice president-engineering, Hayes Mfg. Co., Milwaukee, Calif.

Dr. Ernest H. Kline, a vice president, Aerospace Corp., and general manager of the company's unclassified Space Division ("Cold") Operations.

Lloyd E. Kelly, executive vice president, Link Division of General Precision, Inc., Buffalo, N.Y., and Dr. John M. Head, senior vice president, chairman of the board.

Walter A. Frazee, vice president, Land Air, Inc., a subsidiary of Dynamics Corp., and present manager of Land Air's Instrumentation and Electronics Division, San Leandro, Calif.

Dr. F. H. Borland, vice president research, G. T. Schleicher & Co., North Haven, Conn.

George C. Stewart, vice president/Eastern representative, Air Logistics Corp., Franklin, Calif., with offices in Washington, D.C.

A. H. Sonnenberg, vice president, Federal Scientific Corp., New York, N.Y.

Arthur E. Thalke, vice president/aerospace manager, International Precision Corp., New York.

Av. Commander Cyril John Radicek, Senior Av. Staff Officer, RAF Maintenance Command, with acting rank of Av. Vice Marshal.

Gen. W. D. Hart, assistant vice president of public relations, American Airlines Inc.; also chief executive vice president, Scott C. Whiteley, for state and non-airways affairs (New York), and George A. Weeks for basic maintenance (Tulsa).

Walter S. Boone, R. director, Space Division, Space Dev. Div., Phila. Chestnut St.

C. J. Harrelson, vice president, Lockheed Manufacturing Co., Chicago, Ill.

Lawrence J. House, corporate vice president marketing, America Electronics, Inc., Fallbrook, Calif.

Robert J. Trennan, vice president, Communications Engineering & Research Co., St. Louis, Calif.

### Honors and Elections

Rep. Otto Glass (D-Ark.), Chairman of the House Committee on Science and Astronautics, has been reelected as president of the Air Traffic Control Association in succession to his predecessor, Rep. John W. McCormack (Mass.).

Robert H. Walensky, president, research and engineering of General Dynamics Electronics-Wes-Wards Inc., received the American Society of Mechanical Engineers' Spirit of St. Louis Medal for 1962 in recognition of his role in the design and development of the space shuttle.

Vincent J. Rehak, director of engineering for Martin Co.'s Electron Devices, has been appointed chairman of the National Aerospace and Space Administration's Research Advisory Committee on Micro- and Space Vehicle Structures.

(Continued on page 118)

## INDUSTRY OBSERVER

► Full-scale model of Aerjet-General Corp.'s propulsion system for the Apollo service module is being test-fired in tests up to 76 sec duration in a series of one-level tests at Akron, Calif. Purpose is to determine performance and thermal properties, including thrust chamber vibration characteristics. Projected to have a reliability factor of 0.9999, the engine is approximately 52 ft long and is designed to develop approximately 22,000 lb. thrust at altitude. Nozzle will have an unusually large exit plane diameter and a publishing section of ±10 deg. Titan 2 propellants will be used, as well as a modified Titan 3-type injector.

► Japanese government is planning to establish a space development agency, probably in fiscal 1964. Kappa sounding rocket research was launched successfully at Kagoshima Space Flight Center, at southern tip of Japan. Yugoslavia already has purchased the Kappa-3 from Japan, and other countries have expressed interest.

► During recent Army and Tactical Air Command Strike 2 trials in the Comanche II aircraft, measured 24 hr. to obtain, process and distribute aerial reconnaissance photographs showing deployment of fast-moving forces, a situation which shocked two Pentagon observers. Maneuvers were intended to demonstrate mobility and fixed-wing fighter.

► Japanese Defense Agency space mission is in the United States for discussions with Hughes Aircraft, General Electric and Litton, the three finalists in a competition for the Basic Air Defense Command Environment (Bache) system, Japanese equivalent of the U.S. SAGE system. Contracts probably will be selected early next month. Each U.S. company is headed with a Japanese manager director for the project.

► Weather Bureau officials are interested in a Navy proposal for a system of surveillance satellites in a medium-altitude equatorial orbit which could provide television pictures of large portions of the earth's surface. Coverage would show weather conditions and disposition of shipping.

► Air Force may substantially increase the funding for its satellite inspection (Soref) program, perhaps doubling the funds originally allocated for the program during the coming fiscal year. Additional money is required to cover sensor enhancement, orbital optimus testing and some non-contractual changes made in the program since its inception.

► Lawrence Radiation Laboratory of the University of California has completed a preliminary inquiry in the nuclear industry and is expected to issue a report, probably this month, for a proposal for a single or two-stage booster. It will be built of existing hardware and will carry a 100 lb payload to an altitude of about 250 mi. for nuclear radiation measurements.

► National Aerospace and Space Administration probably would be receptive to training Japanese space pilots should a program develop so that country for training astronauts for future flights in space exploration.

► USAF Special Weapons Center at Kirtland AFB, N.M., is planning an ambient study program to predict accurately the effects of specific nuclear warhead yields (kilotons) on the operational lifetime of a satellite in orbit. Predictions of radiation flux is to include energy, angular distribution, building, levitating, rotatting and secondary sources of radiation in spacecraft using nuclear power.

► Air Force is expected to select a contractor next week for its multi-sensor airborne geodetic mapping system, USQ-35 (AW Sep. p. 33). Leading candidates for the contract are Astronautics Division of Ford Motor Co., General Precision, Minneapolis-Honeywell and Northrop.

► USAF will soon launch a Discovery satellite from Vandenberg AFB, Calif., equipped with special experiments to measure degradation of solar cells in the ultraviolet radiation belt created by the July 9 high-altitude nuclear explosion (AW Oct. 1, p. 24).



All-Bendix space communication equipment undergoes extensive qualification and resistance testing in thermovacuum environmental chambers.

**ADVANCED SATELLITE REPEATERS** are the result of three years of continuing development to improve efficiency, stability, thermal balance, size, and weight. This is one of the many space projects at the Bendix Systems Division, where engineering opportunities exist from initial electronic and space vehicle design through assembly and field operations. Write or call Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

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## Washington Roundup

### Soviet Nuclear Aircraft

Soviet Russia's nuclear-powered aircraft program has been postponed from an experimental program based near Moscow to development of an intermediate-size aircraft, with work being done in the Tbilisi nuclear research complex near Soviet Georgia. One of the new programs is an anti-Polish strategic weapons system with sufficient range to reach Poland's eastern areas, enough payload capability to carry large electronic detection gear and nuclear depth bombs, and endurance that would allow it to stay in the stratosphere as long as possible.

Lately, declassified Russian sources still being used as the nuclear aircraft program, but a new version of this aircraft has appeared in the Soviet Union with six engines instead of three, deployed in the Tu-160. As shown in July 15 issue (AW July 17, p. 101), new engines are estimated to be in the 35,000 to 40,000-lb thrust class and should give the aircraft Mach 2-plus performance.

### Science Board Changes

Defense Secretary Robert McNamara has ordered that the Air Force Scientific Advisory Board—which now has approximately 175 members—be cut in half and be made responsible to the Air Force as well as USAF's. An Air Force Scientific Research Board will continue to be responsible for the management of the board's full general meeting at the Board of Air Force Science, Tel. 325-27.

Theme of that meeting is defense work in space. The tentative agenda includes a defense, air force, aerospace space plan by John Rebil, director director of defense research and engineering; and discussion groups on topics involving unique military aerospace missions and Soviet military space capability that the next decade.

Watch for Air Force to approve its decision to buy Vertol 107 turboshaft-powered helicopters for its SCOB-108 long-range mobile helicopter requirement (AW Sept. 1, p. 25) and switch to the Sikorsky HSS-2. Details will be announced mid-September. Problems on delivery schedules and price caused the change in vehicles for the search and rescue role and Texas radio tower support mission.

### Internal TFX Struggle

Internal fight appears to be brewing in the Office of the Secretary of Defense over the heavier TFX fighter fighter for the Air Force for selection at a single developmental production source this year. Defense Research and Engineering officials feel that they have paved the differentiation of TFX requirements so well as to say that the weapon system will be technically sound and that there will be only about a 15% difference between the USAF and Navy versions (see p. 37). That was the project criterion is now in place.

But the program review office under Assistant Secretary of Defense (Comptroller) Charles J. Blitch is arguing that the cost-effectiveness basis of the TFX does not warrant developing two separate aircraft and the other part of the weapon system. Most of the cost-effectiveness review is performed under Defense Assistant Secretary (Programs) Frank McCullough in the department's financial planning and systems analysis. In the letter headed by Alan Enlowton, a team of Dr. Donald H. Schrader, Vernon K. Hayman, Dr. Jacob A. Stadlauer and John E. Kelly, nuclear system analysts in technical wings of DODRPA's technical division.

TFX is not the only issue. The Enlowton team has gone directly to the services and to contractors to obtain information on a variety of small and allied programs. The services have taken advantage of this to no. to change what they consider inferior communications coverage from DODRPA.

Pentagon Kennedy has promised Rep. David S. Klehr, Utah Democrat who is fighting for the Senate seat held by Republican Wallace T. Bennett, that he will help in whatever way he can. Interpreted by Enlowton, this means he can be marshaled as contractor before November elections (AW Oct. 5, p. 16). Klehr also has last week in a press release that he would sign off if a deal is concluded. He is expected to travel to DODRPA on Oct. 30 in a private visit with President Kennedy, which he said was the first he has had relating to Senate seat issue.

U.S. Strike Command has been asked to study Army proposals for radical increases in strength and an Air Force series of these proposals before Senator McNamara gets them a final going over. Army's F-117A Advanced Support Requirements Board, headed by Lt. Gen. Hamilton Howlett, offered five plans for strengthening Army air forces, based on current priorities. The most expensive would boost the size of Army's fighter aircraft program from the current \$1.8 billion to \$5.4 billion.

An Army transport board, headed by Lt. Gen. Gabriel P. Docherty, took exception in Army's use of such terms as transport aircraft in the definition of AC-1, C-141, and AC-146. Following out-of-pocket costs and the Canadian AOR-1 Molark reconnaissance aircraft later p. 37, Army should specify them. It also took under consideration to what it called an emphasis in Airforce's in the development of VTOL and STOVL aircraft.

—Washington Staff



MA-8 LIFTS OFF from launch pad as seen in photo at left. Credit: Atlas over with the Atlantic Vaginail extends from Atlas booster as shown in photo at right.

## Flawless MA-8 Flight Advances Mercury to

Cape Canaveral—Safely, uneventful Mercury MA-8 flight by Navy Capt. Walter M. Schirra will allow the Mercury program to move directly to its final objective—a three-man—with only minor changes necessary in the basic capsule.

Cape's joint Sigma-7 capsule was launched at 8:19:11 a.m. EDT from the Atlantic Missile Range, as the sunburst or moonburst version selected for a second flight. He landed at 14:00:01 a.m. after traveling 1,000,000 mi., 529 pds (DE), 130 sec. and 100 sec. maximum altitude. The capsule of the MA-8 mission, which had been held in the center of the previous successful recovery zone, he flight was his longest U.S. orbital space mission, and was conducted primarily as an engineering test flight designed to assess orbital navigation and communication of command modules. Apogee was 176 mi., perigee 100 mi., period 88.9 min., and inclination 32.5 deg.

From an engineering standpoint, Capt. Schirra experienced none of the system problems reported by Mercury

Lt. Col. John H. Glenn in MA-6, and Lt. Col. Scott Carpenter in MA-7, particularly on events caused by an oxygen tank explosion had 80% of his fuel remaining when he began his reentry maneuver.

Immediately after Schirra was picked out of the water by the NASA career Kennerly, Mercury Operations Director Walter G. Williams and the flight was "perfect."

There were no spacecraft malfunctions whatever. There was no problem with the capsule. Williams said the flight will move a Mercury to the day-long mission. This means the second orbital flight will be canceled (AW Oct. 1, p. 21).

### MA-B Coverage

Another Week & Space Technology's coverage of the Mercury-Atlas 8 mission was provided by Space Technology Editor George Alexander at Cape Canaveral and West Coast Editor Irving Stone in Honolulu.

Possible change in the capsule capsule will be reviewed if the 750-lb. percentage weight of the periscope will be replaced by environmental oxygen reaction control fuel, and not oxidizer water (See box p. 29).

Schirra was able to rod his orbital mission with a large amount of fuel remaining because he spent a considerable portion of his flight drifting, that is, using only limited or no power control of his capsule.

Drift flight, a unique experiment of the MA-7 mission, was accomplished in two phases: boosted and full. He spent 11 sec. in full drift and 16 min. in boosted drift.

Boosted drift began at about 11:25 a.m. EDT, shortly after Capt. Schirra entered his third orbit. During his first two orbits, the pilot had exercised all four modes of the attitude control system—autonomous, On-by-hand, rate stabilization and manual precession.

In boosted drift, the autonomous mode of the control system was locked out and the Mercury capsule was allowed

### Day-Long Mission Next Year

To bring around one of its three axes, within the 30-day limit of the zero mass test's orbit, Capt. Schirra started to extend the 30-day limit, the pilot could have brought the capsule back to its correct attitude by using any one of the three modes activated by his own volition, or by reverting to the autonomous method.

When no attitude rates along any axis were noted during boosted drift, Schirra rotated the control system, pitched his capsule up 34 deg above the local horizontal and prepared to activate the zero and entry sequence, should it have been commanded by the Mercury Control Center.

When he received authority to proceed on to the fourth and fifth orbits, Schirra again shot down the ABCs control rods, and as gravity caused the alternating current bus, and the C and S-band boosters. For long periods during the fourth and fifth orbits, the Sigma 7 spacecraft was beyond reach of tracking stations in the South Atlantic and the Pacific, and no telemetry signals were sent, conserving electric power.

### Day drift flight was not permitted

during the iterations from third to fourth and from fourth to fifth orbits, because of the possibility that the flight sight base had to be reacquired and the capsule would have had to be in the right attitude for transfer of the astronauts. Once up on the third and fourth and fifth orbits, therefore, Schirra maintained the control system, pitched his capsule up 34 deg above the local horizontal and prepared to activate the zero and entry sequence, should it have been commanded by the Mercury Control Center.

On the night side of the earth, Schirra selected a responsible return posture, then vowed he wouldn't be breaking out the capsule window and losing the posture, for then strangled to losing Sigma 7 back to its original orbit.

On the night side of the earth, Schirra was to have used a star or star field as an reference point. Carpenter reported difficulties in aligning his capsule with the stars, so he had planned to drift during the four and five orbits to study the possible gravitational effects of the slow rotation.

Because of the drifting flight espe-

cially was to conserve hydrogen peroxide fuel of the control system, so that it would last throughout the on-orbit flight, and to determine what moments of inertia might cause attitude changes in a freely drifting body. Mercury program officials were interested in the size and duration of these moments and their possible effect on the pilot's capability to execute programmed tasks.

Had an emergency shutdown occur during full drift flight, Schirra would have had to use one of the three attitude control jets to stop, because of the impossibility of stopping the capsule in time.

Schirra was credited for the on-orbit management of the control system's fuel supplies. Flight experiments established by Mercury program officials called for a maximum of 45% hydrogen peroxide remaining in the control system's tanks at the end of three orbits before an alternative descent could be granted to his flight. At the beginning of the module sequence, the requirement was 55% of fuel remaining.

Nearly five hours after lift-off, Schirra had used only about 16% of his control fuel and had approximately 56% left at the two independent tanks as he began reentry.

The fly-by-night mode of the control system was enabled by the addition of a panel switch, which when depressed, locked out the high 24-lb thrust gen. This permitted the pilot then to use the one-pump thruster without fear of repeating Scott Carpenter's experience during the MA-7 flight of accidentally triggering both the high and low thrust gen. instruments. Carpenter depleted his fuel during his flight (AW May 25, p. 2).

Because of difficulties experienced by Carpenter with the on-orbit attitude, the MA-8 pilot was called upon to test his ability to dominate one posture through a reorbit on the window and to correlate these observations with panel instruments.

On the night side of the earth, Schirra selected a responsible return posture, then vowed he wouldn't be breaking out the capsule window and losing the posture, for then strangled to losing Sigma 7 back to its original orbit.

On the night side of the earth, Schirra was to have used a star or star field as an reference point. Carpenter reported difficulties in aligning his capsule with the stars, while doing a 3-million-coulombs electric impulse while doing a Dohor, South Africa, because of broken clouds and

## Martin Has Nova Study

Washington—Marshall Space Flight Center has received a \$100,000 contract to conduct the post-flight study of Nova launch vehicle statistics (AVN Sept. 26, p. 14). Marshall congressional subcommittee held the hearing.

First part of the study will develop preliminary information on failure rates for the most promising Nova configurations, and will be due Dec. 14. Second part, to be due next May, will make a detailed analysis of each promising launch concept.

Just over 10 minutes, the pilot reported he saw the three flares as a single bluish glow of light in the dim-star expansion. As he passed over Durban during his fifth orbit, cloud cover prevented him from seeing the large Sunstar satellite that he did see the lights of Perth, Australia, as the people there turned on their lights for him in their first fire.

Two officers on the Indian Ocean tracking ship, *Coral Seal*, reported a visual sighting of the Sigma-7 capsule as it passed over the track of the second and 12th orbits. The bearing of 170° deg. from the west. The night, the officers said, correlated with tracking plots. They and the spacecraft appeared brighter than Venus.

The MAF pilot also earned a hand-held 35-mm camera similar to the one used by Gleason last February and attempted to take photographs of meteoroids, dust clouds, solar-flare fields, sunspot regions, and other remarkable features of interest to NASA's Goddard Space Flight Center.

The pilot carried food on both parts and ate breakfast and dinner during the fifth and sixth orbits. Food consisted of a mixture of baked and vegetarian casseroles and soups in tubes. Cakes had consisted of chocolate cake, caramized fruit and nut bars, fruit cake and grape cake. Six pounds of water, contained in two flat bottles with expandable tubes, also was carried on the spacecraft.

MAF also tried an evaporation test bed for an experiment with various advanced heat protection materials. The material samples were provided by Avco Corp., NASA Langley Research Center, and McDonnell Aircraft Corp., Boston. During the flight, Weight Corp. and General Electric Co. participated.

Goddard Space Flight Center also started two evaporation tests, each weighing about one pound, on either side of Schmitz's module to study radiation exposure at the ultimate flares in Sigma-7. Oil-particle content to Goddard was the energy spectrum of low-energy cosmic-ray particles, high-energy gamma rays and x-ray particles.

Only one hold was encountered in Schmitz's module and this was occasioned neither by the McDonnell capsule nor the Atlas booster, but by a breaking stud at Grand Canary Island station. The hold lasted nine minutes.

The pilot was awakened at 10:40 a.m. on nine minutes later are EDT), six minutes at 1:30 p.m. and underwent a postflight press conference. In Flight Surgeon Capt. Howard S. Morrison, USAF physician, by 4:25 a.m., the pilot had his bioassay attached and had been seated in his chair. Schmitz left hangar 5 at 7:45 a.m. and, along with Captains G. F. and J. C. Schatz, arrived at Cape Canaveral at 9:23 and entered the capsule at 9:47. Hatch sealing procedures began at 9:59 and were completed by 10:20.

During Schmitz's first orbit, Marshall Control Center and he transmitted a blood pressure reading almost simultaneously. The capsule reentered and was around 10:45 a.m. EDT. The center said it had lost both temperature measurements and was watching Schmitz's overall condition and was temperature clearly for signs of circulatory. Once assured that the measurements were lost and gone to launch.

Like Captain before him, Schmitz had a problem with the right turn temperature sensor which was located in the cockpit floor. It sat about 1-3/4 ft. and the reading affected controls the amount of water passed over a heat exchanger—the higher the number the more water was sent to the seat.

One observer and Captain ran up and down the aisle slightly as attempting to adjust the seat temperature, but that method failed. Turning the water on the exchanges Schmitz ran wastewater to move along the seat more slowly, going from 3 setting of 75 up to 30 in last step. He finally settled around 6-7 ft. and the temperature was declared to be no longer a problem at 11:05 a.m. Captain followed him immediately ending the same one call.

Flight and Hospitalist just reported to be about 5% and it settled out at around 7% after the early part of the flight.

After the flight, Dr. Maxine reported that Schmitz's heartbeats ranged from 60 to 120 beats per min. over the course of the entire flight, but averaged in the mid-60's for the most part. Breathing rate was from 15 to 20 admissions per minute and blood pressure was normal.

During the first orbital flight, Schmitz carried all attitude control systems modules. Toward the end of his first orbit, he switched his capsule down 75° right, for the first experiment conducted at Woomera, Australia.

During his second orbit, Schmitz said that he "had some fun," and that he enjoyed the role of space pilot, but that he was able to cause their appearance.

Coupled with Carpenter's similar experience, Schmitz's experience gives credence to the theory that the particles originate on the capsule itself.

Schmitz orbited his third orbit at 11:27 a.m. Toward the end of this orbit, Schmitz went into limited drift flight. What could be fellow Astronaut Virgil "Gus" Grissom that he had been too busy to allow Mercury control to go for its orbit, the pilot responded.

Powers' value, beginning at 12:55 p.m., and the fifth, beginning at 2:31 p.m., were spent in full drifting flight. The two orbits were about 10 minutes apart each and one NASA spokesman said, "It's typical of a two-orbit attitude, but that the motion around each axis appeared to be random and revealed no clear-cut pattern." Performer of Control Division/Astronautics Atlas booster was smoothly and well within tolerance limits. Booster engine cutoff was about 7 sec. and maximum engine cut off about 10 sec. late in comparison to the static booster burning time. Orbital injection velocity was 17,663 mph, about 20 mph faster than planned, but very well within tolerance.

A new 100-watt (10W) antenna was deployed on the front of the attitude control pack to acquire communications with ground-based stations. Microcar progress module was placed with its equipment.

The antenna, basically a dipole, can consist of two separate segments of

## Interstellar Missions

Cochran, Ober-Illintzsch's son, son of less than 30 years now appears reasonably popular with established scholars and other firms or bodies of publication criteria.

The greatest engineering problem involved in the three approaches to interstellar flight is the mass limits, say the two leaders of these varying research vehicles.

A typical orbiter might have on one of 10 to 15 m, ranging from high values according to Dr. F. Spiegel and L. D. Julie of Jet Propulsion Laboratory. En route high levels of magnetic field strengths—the value of several hundred thousand gauss might be required to reduce the plasma produced for power. Wind power, the losses in the system because of its inefficiency, would be enormous.

Major engineering problems remain in all advanced space propulsion systems, according to Spiegel and Julie. Detained development of systems using electrical power generation, testing for the extremes of materials have major issues where the problems for a still long and the answers are not in sight.

headlines, orbited first along its long horizontal axis to form a hull. It was then strengthened and was rolled up into a roll of paper. After completion of capsule and payload, the craft expanded to its then full 13 ft. 8 in. length and then rolled out a teardrop shape.

Problems are reported to sources to be the constructional and the use of a static airlock system for gas inflation. Considerable to be added to the MA-8 spacecraft and different gearhead versions, but these areas as related to atmospheric conditions and not to any equipment malfunction which obscures the capsule or its ground status.

The decision to go beyond three orbits was based primarily on the fact that 100 days were, the pilot and had 90% of the mission had fuel remaining. At 100 days, still is drifting flight, but that's not the case.

During his fourth orbit which was completed at 2:15 p.m., the Sigma-7 spacecraft was stationary. Schmitz told Hooten the stand was run successfully.

Cdr. Schmitz said Flight Director Christopher C. Kraft was supporting his flight, and Kraft advised the pilot where to look in attempt to spot the Echo satellite.

On the fifth orbit, Schmitz was released to take closed-circuit photographs for a 30-min. period, and he took six images spaced sequentially from a tube. The MA-8 pilot began his with a final orbital maneuver at 1:44 p.m.

Ford 90-mm pilot was spent giving out the necessary checklist, and then checked off the items necessary to complete the 34-day rendezvous module for the module assistance. Cdr. Schmitz had an appointment at 5:37 p.m. Although Mercury orbital and there was a 2-min. delay in this instance, the Sigma-7 capsule took up rapidly as target, within five minutes of the primary mission. Four flights, the carrier Recovery, which was viewing with its distance from about 110 m northeast of Woomera.

Pacific tracking ship, *Whidbey*, tracked the capsule through its route to landing. First visual sighting of the capsule was at 7:35 p.m., and it landed at night at the Recovery base.

On landing, Cdr. Schmitz said he was in fine shape and he elected to remain in his capsule until it was hoisted by aircraft truck to the Recovery deck at 6:05 p.m. Capsule escape hatch was blown at 6:17 p.m., and Schmitz came out after being hoisted by helicopter 13 hr. 26 min.

The MAF pilot returned congratulatory telephone calls from President Ronald and Vice President Johnson. The Vice President also wired his to his Texas totals in November to land. The New Jersey congressional delegation and Cdr. Schmitz will be honored at a

## Mercury Atlas-9 Capsule Changes

Cape Canaveral—Mercury Atlas-9 mission capsule, scheduled for a half 24 hrs. orbit flight only just, is reported to weigh about 4,200 lb.—65 lb. less than the weight of the Mercury capsules flown so far. Weight result goes with the addition of scientific instruments, however.

Problems are reported to sources to be the constructional and the use of a static airlock system for gas inflation. Considerable to be added to the MA-8 spacecraft and different gearhead versions, but these areas as related to atmospheric conditions and not to any equipment malfunction which obscures the capsule or its ground status.

To find that the capsule will be within range of at least one tracking station and one additional station on each orbit, the Pacific Commanded Stand East Coast will be moved from the western Pacific station held for the Mercury Atlas missions to a point off the western coast of South America. This would indicate that additional stations may be given a capability to measure whether Pacific stations and the East Coast will have this capability.

Problems are more severe in a 24-hr. mission for three reasons: the performance results of Cdr. Walter M. Schirra's performance in MA-8. Mercury Flight Director Christopher C. Kraft called MA-8 "the best [flight] we've had yet." He praised the pilot's performance, saying Schirra has the capacity "to fly in naptime."

Plane pilot candidate for the next Mercury mission is USAF Maj. Gordon Cooper (AW, Oct. 1, p. 22). He would spend a considerable part of the one-day mission in drifting or limited date flight. Use of these techniques apparently will alleviate the fuel depletion problems experienced in MA-6 and MA-7 missions.

homesteading in Deadlift on Oct. 15.

Apparatus house and geographic positions projected for Pacific interstellar flights were either land-navigation at T-4-3 to 44 min., then do down with land navigation, 140 deg. east longitude, or T-4-3 to 44 min., then do down with a passover page. Navigation Aids Review Center under Gen. William P. Driscoll, situated near T-70 Concord, Mass., and Rader Air Force Station, Calif., will direct interplanetary flights to specific destinations in remote areas.

Ross Kraft, the Pacific command ship, was 500 mi. north of Guam between the island and south eastern tip of Palau. The island and south eastern tip of Palau and the east of Manila. Sixth flight drag was due north of Palau, and seventh due north of Manila. The eighth due north of Palau, and ninth due north of Manila. The tenth due north of Palau, and tenth due north of Manila. The eleventh due north of Palau, and eleventh due north of Manila. The twelfth due north of Palau, and twelfth due north of Manila. The thirteenth due north of Palau, and thirteenth due north of Manila. The fourteenth due north of Palau, and fourteenth due north of Manila. The fifteenth due north of Palau, and fifteenth due north of Manila. The sixteenth due north of Palau, and sixteenth due north of Manila. The seventeenth due north of Palau, and seventeenth due north of Manila. The eighteenth due north of Palau, and eighteenth due north of Manila. 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# New Study Contracts Awarded In MMRBM Program Definition

Washington—Defense Department has selected single contracts for the mobile midcourse ballistic missile (MMRBM) program definition phase for propulsion, entry-vehicle and transpo-lander bidders, and is expected to name a single contractor soon for the integration, assembly and checkout role.

Thermal Control Corp. was the propulsion vendor, Aerospace the entry-vehicle prime, and Guidance, Avco Corp. the transpo-lander. Hughes and Northrop are contractors for the integration role.

Orbital Precision, Inc., had been selected as a single source for payload definition phase on the guidance and control system. The only part of the MMRBM program in which two contractors will be used for payload definition is the command and control subsystem, where contracts go to Hughes and a team consisting of Martin and Schlesinger.

The Phase 2 development contracts are expected to go to the same companies, at a decision is made to proceed with the MMRBM, except for command and control. There, a single contractor will be selected from the initial phase, expected to be completed within three years.

The ultimate fate of the MMRBM is still uncertain, partly because European nations within the North Atlantic Treaty Organization are where the weapon is intended to be located to base it within their borders or finance its development and production. But the

## VJ-101D Tested Trials

Test flight model of the West German VJ-101D VTOVL aircraft, the first of four units ordered, followed flight tests at Messerschmitt's Munich flight test facility since July according to Dr. Gernot Kauschke, retiring corporate president of the West German air force. Kauschke said a test prototype of the VJ-101D could be available within two years.

There are indications, however, that Lt. Gen. Werner Frentzel, Kauschke's successor at the top of the force post, will take a serious look at the program possibly canceling the atmospheric portion, which has been programmed in a long-range reprogram for the Lockheed F-104G. The decision on the hypersonic portion would be made as a result of any large increase in cost. Work on a less-expensive VTOVL class aircraft replacement for the F-104G is expected to continue.

winning contractor for the program definition phase will have the advantage of obtaining development funds if the Defense Department decides to name the MMRBM to completion.

Industry observers also noted that the award to Aerospace for entry-vehicle studies pushed the firm further into a field largely dominated by the Avco Corp. and General Electric Co. Federal Systems Corp. of Rockville, Md., was not named from high-suspension, and the Ford Instrument Co. Division of Sperry Rand will be associated with Aerospace in the entry-vehicle studies.

Last night's awards were announced after DOD had reviewed the field to two proposals. Award notifications were to be received by March 20, and RAs say there are 4 half-dozen final entries for the new DOD.

The engine will be provided by two Turbomach 21 engines with 130 shp. It will be jetisoned and will sell for \$75,000 fully-equipped with a 6-to-10 place interior and electronics, including radar.

## First Civil Sabreliner Set in March

Pittsburgh—First delivery of a civilian version of the North American Aviation F-5 Sabreliner jet, now called Sabreliner, is set to begin next March. Flying model will be made next March to Braniff Western, Inc., of St. Louis, issued last week by North American as its first customer.

The Sabreliner manufacturer stated at the National Business Aircraft Assn.'s 15th annual convention here that the 500-shp Sabreliner will sell for \$75,000 in basic-bill configuration and can be fitted to a modification center for installation of cabin furnishings and equipment. Fully furnished and equipped, all options, it would sell for \$80,000 to \$90,000.

Braniff-Western and Avianair, Los Angeles, are West Coast representatives to handle east Sabreliner sales and marketing.

Wilson Bennett, president of the distributor and his wife, have seven or eight prospective customers for the Sabreliner executive model. A deposit of \$15,000 will be required to establish priority for delivery.

In other NBAA activity, there was a clear need that the larger share of business aircraft sold over the next 3-10 years will be turboprop-powered, although a number of new craft will compete in the Avco Commander 1121 class. It appears that there will be a sizeable volume of customers for gas-turbine-powered aircraft in the Boeing 727 class to turboprop aircraft as the new powerplants become available.

## Caribou 2 Engine

Washington—General Electric turboprop engine has been chosen by the Army to power its de Havilland AG-2 Caribou twin-engine short-haul and landing transport.

The C-130, which will have a fixed-wing landing gear, will be the successor to the AC-1, built by Fairchild-Whitney. The engine, which is now in Army service at Southeast Asia and the continental U.S., has contracts for the aircraft in England have yet been signed.

A firm subcontractor of future turboprop contracts was chosen at the first display of the International Defense & Space Show, held here by the Royal Canadian Air Force Association, at Ft. Lauderdale. The first flight is scheduled next March, and RAs say there are 4 half-dozen final entries for the new DOD.

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## Avco Corp. to Supply Minuteman Mark 2

Washington—Avco Corp. Engineering Division has been awarded a \$39,565 contract for production of improved guidance memory vehicles for the Air Force Minuteman intercontinental ballistic missile.

Development of the Mark 2 20-entry body was conducted at the Avco Research and Advanced Development Division under a previously announced contract which amounted to more than \$22 million.

Production of the Mark 2 will be at the Lexington plant in Stratford, Conn.

A small quantity Minuteman II to vehicle competition is now in progress, with proposals due at the Ballistic Systems Division next week.

## Naval Air Chief

Washington—Vice Adm. William A. Scherer, who is present as commander of the US Submarine Fleet in the Pacific, will replace Vice Adm. Robert B. Peur in deputy chief of naval operations for war in November, as predicted in Aviation Week (Aug. 20 p. 28).

Retired Adm. Thomas H. Moorer will become Submarine Fleet commander Oct. 1 with the rank of vice admiral. Until recently, he was director of the Navy's Long-Range Detection Group in the Office of the Chief of Naval Operations

# Explorer 14 Sends Valuable Radiation Data

By George Alexander

\* Cosmic Ray, developed by NASA's Goddard Space Flight Center. This instrument studies double ionization rates, television, a magnetic field, radiation self-dose dosimetry and two connected particle-type Geiger counters, to measure, respectively, total cosmic ray flux, proton flux above 700 ev, and the low-energy portion of the solar particle spectrum. Ion energy passes are proton from 3 mev, and incident protons from 10,000 ev to 20 mev, and proton flux above 700 ev, electrons above 500 ev and cosmic rays above 75 mev.

\* Ion-Electron Detector, developed by Goddard. This device is to measure particle fluxes, type and energy as a function of direction, time and position within, above and below the Van Allen radiation belt. Range of the detector is 10,000 ev to 100 kev, and the total energy detector from 3,000 ev to 3 mev for proton and from 100 kev to 500 kev for electrons.

\* Solar Cell Damage, an experiment developed by Goddard. This experiment was designed to compare the detection of Po-210 and Na-22 polar cells when exposed directly to radiation (AVN Sept. 17, p. 32). Two types of Po-210 and two of Na-22 cells, 10 cells to each strip, were mounted on the tail of the octagonal section of the satellite. One strip of each cell type and the second was 30 kev.

\* Use of the six experiments carried on board Explorer 14 were continued during the Van Allen belt study, with no apparent section of the satellite.

\* Particle Analyzer, developed by NASA's Ames Research Center. This instrument, measuring 3.6 x 3.6 x 3 m, is to determine the spectrum and flux of low-energy protons beyond 24,000 mev. Energy range to be measured was from 2 to 20,000 electron volts, within ±5%.

\* Trapped Particle Radiation, developed by the State University of Iowa, to measure cosmic rays and different particle conditions throughout the satellite's orbital path. Sixteen fine丝 experiments from Geiger counters. One was to test that shows on Explorer 7 and 12, was manufactured and measured its operating potential at 20 mev (radiation damage), volt and electron flux 1.6 eV.

The other three, also measured a magnet in trap low-energy electrons at 2,000 ev and above. Two of the tubes were to detect protons at 50,000 ev and above, and the third at 4 mev and above. Aside from the low-energy electron tube, the other Geiger counter is to sample electrons at 25,000 ev and above.

While the other strip was unprotected, Goddard hopes to compare results with those obtained with both protection.

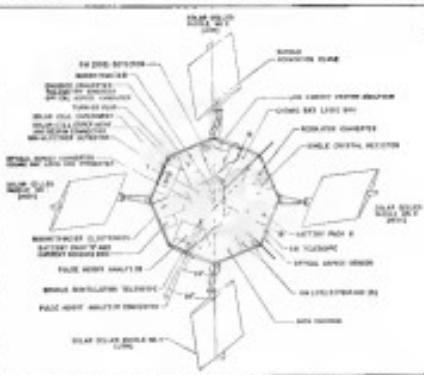
\* Magnetic field, an experiment developed by the University of New Hampshire to measure the magnitude and direction of the magnetopause magnetic field between 20,000 to 100,000 miles, and the low-energy portion of the solar particle spectrum. Ion energy passes are proton from 3 mev, and incident protons from 10,000 ev to 20 mev, and proton flux above 700 ev, electrons above 500 ev and cosmic rays above 75 mev.

\* Launch monitor for Explorer 14 was approximately one year old and was delivered both by solar heating methods and lighting conditions at time of separation. The entire solid heating of the experiment and electronics aboard the satellite, which was launched on a trajectory at a right angle to the earth's surface.

The quadrant abeam plot presented the four face showing the projected during third stage spacing and count at an angle greater than 30 deg.

By launching between 3 and 6 pm EST, Goddard was able to limit the time that the spacecraft was within the earth's shadow during its long climb to apogee from a possible 65 hr to roughly 7.5 hr.

Explorer 14 equipped with four solar panels which were exposed at the protective perfboard facing was jettisoned shortly after second stage fueling was completed to reduce total weight.



EXPLORER 14 (3 lb) experiments are detailed. Satellite's expected lifetime is two years.

# Early Inflatable Micrometeoroid Paraglider Re-entry Tests Planned

By Irving Stone

**L**os Angeles—Two of the three initial able micrometeoroid paragliders (IMP) being developed by Space-General Corp., El Monte, Calif., for NASA's Langley Research Center, are programmed to be the first vehicles of that type to undergo earth reentry tests when they are flight-tested early next year.

Paraglider prototype model (AW-Jest 4, p. 37) will undergo structural and environmental tests late this year to establish compatibility with space and reentry regimes.

Frigates were to demonstrate, as a design to satisfy glide characteristics, the capability of the vehicle's capacitor-type micrometeoroid sensors, and measurement of the flat and penetrator nose properties of micrometeoroids.

Inflated IMP configuration is approx. nearly 13 ft long, and about 20 ft wide at the aft end. It includes a tubular curved nose cap, 20 in. in diameter, and two tubular leading-edge booms and

a center or load boom, each 20 in. in diameter at the forward ends (where they join the nose) and tapering to 5 in. in diameter at the aft ends.

Vertically, tubular sections appear nearly 12 ft long and 12 in. in diameter as suspended from the load boom, and is mounted with cables from the load boom section. Material for IMP's initial protective coverings is 0.035 in. thick, made of glass fiber coated with silicone resin, and is designed to take pressures of 14 psig plus a safety factor of 5, and temperatures up to 1,700° F. for about 16 sec.

Meteoroids, or nubs, which extend from the leading edge booms to the load boom, present an area of approx. nearly 113 sq. in. (Std material), similar to that used in inflatable sections, or about 0.005 in. thick.

Paraglider payload is carried at the bottom of the vertical shroud. Retracted portion of the payload contains a hydrogen pressurizing bottle, center fair housing paraglider deployment and reentry orientation, beacon, a percent-

masking white IMP is in space and during its glide to ground, and a salvaging system to maintain a constant pressure differential of 14 psig between the inflated sections and ambient pressure during reentry, and a reduced pressure of 5 psig thereafter.

Payload also includes a nose cone, positioned below paraglider recovery, which contains power supply, pyrotechnics, instrumentation, and telemetry.

Weight of recoverable portion of payload (excluding that of the pressurizable nose cone) is approx. 14 lb, and weight of the paraglider glider skin is 45 lb, giving a wing load (including 0.5 ps) of 0.5 lb per square foot.

IMP's top and bottom sections are covered with a heat shield of about 110 sq. ft., with capacitive-type micrometeoroid sensors, which consist of five alternate layers of aluminum and Mylar layers are electrically connected so that both micrometeoroid impact and depth of penetrations is recorded and related to the ground.

When packed, IMP fits in a glider section carrier 13 in. in diameter and approximately 31 in. long. The carrier, which is bonded to the glider nose, serves as a base for purposes of mounting the load boom and acting as a load limit during reentry.

Paraglider is inflated in two steps—first a low-pressure dosage stage, followed by inflation to the full 14 psig. A control valve maintains this pressure at altitude, and a relief valve prevents excess pressure during reentry.

Glider is planned to perform a spatial maneuver following reentry into the atmosphere.

IMP is carried into space by a Space General Aerospace 150 rocket. Following instrument burstout, the vehicle is deposed at approximately 350,000 ft., a micrometeoroid separates the sustainer from the motor section of the vehicle, immediately starting up a stepped charge separation system. In the separation, the sustainer pulls a 25-in. wire skin extension into which the paraglider can later be fitted. As the sustainer falls away, it pulls a layered skin which opens the aft-facing canopy, allowing the paraglider to free itself. Following this, the soliton separates at lagena.

The glider needs to a maximum altitude of approximately 200,000 ft, and remains in space above 450,000 ft for a total of five minutes. At 460,000 ft, as the descending part of the reentry, the nose cone is jettisoned by shaped charge action and IMP is ready for reentry. Since the vehicle is not attitude-controlled, it is designed to impact horizontally (no aerodynamic stability) conditions due to advancing reentry as an atmospheric load. The reentry condition occurs at a speed of approximately 5,500 fpm.

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ARTIST'S VERSION of inflatable micrometeoroid paragliders (IMP), being developed by Space-General Corp. for NASA, shows vent cone containing power supplies, pyrotechnics, instrumentation, and telemetry being deployed just before paraglide begins reentry. Sketch shows configuration of tubular structural members and ribs, the latter being curved, top and bottom, with the micrometeoroid sensors.



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# DOD Prepares Conflict-of-Interest Code

By Philip J. Klass

Follow-on development and production will be given to the same company without bidding if competition, then there is no conflict in allowing the company to prepare the specifications.

While the program definition phase is to be followed by an open competition for development and production and where two or more companies have a program definition contract, these would be continued under subsequent management contracts, provided that all program documents are made available to other competitive bidders for the next phase. Thus the Phase 2 qualifications are likely to incorporate the best ideas of the several Phase 1 programs, and those are made known to all bidders as single program definition contracts obtain an added advantage.

Space Technology Laboratories, under contract to the Defense Communications Agency, conducted a study to determine what characteristics are desirable in a communications interface service to make it suitable for defense use. It has been the only such study conducted and all the STL research results were to become the requirements for the new military communications interface service. There, STL would be charged with holding on to the ongoing military telecommunication contracts. But there have been a number of study studies including those made at the Institute of Defense Analysis, the Air Force, and others. All of these reports will aid DCA as it formulates the overall specifications and the STL vision as not expected to dominate. For this reason, STL will be allowed to bid for the upcoming satellite programs.

During these operations could result if STL will sell its recently developed mobile communications satellite general terminals (AW Sept. 17, p. 98) for use with the new military communications satellite system. Although the latter would have to operate at different frequencies than the present design, it is at present unclear whether the existing mobile terminal would be handled by STL or another contractor.

However, the procedures followed in one of the USAF's existing military space programs probably would be followed if it were being awarded today. The contract was awarded to a single company to develop specifications for a new weapon system called a missile to intercept aircraft. The contractor was expected to go out to industry to obtain the best deal. And the DOD for the weapons-airplane communications satellite probably will not be relieved until early next year.

Companies expected to bid on the weapons-airplane satellite include Philco Ford, Grumman, and Lockheed. Contractors for the weapons-airplane satellite are reported to include Boeing, General Electric, General Telephone & Electronics, Hughes Aircraft Lockheed and STL. There is speculation that Boeing and Lockheed may also bid for the weapons-airplane satellite.

However, if the company contract fails to let out all four working on later under government contract, with full access to all details of their work, then the company in action as an agent of the government and should be banned from exploring such knowledge in subsequent competition.

Contract managers are at a loss, probably he two to four months after DOD has prepared a final draft of its conflict-of-interest code.

# Canadian-U.S. Alouette Satellite Shows Perfect Early Performance

Los Angeles—All equipment and scientific experiments aboard the Canadian and U.S. Alouette satellite, orbiting the earth every 105.4 min. in a near polar orbit, were operating perfectly through the middle of last week, according to a spokesman for Canada's Defense Research Telecommunications Establishment in Ottawa.

Joint Canadian National Aerospace and Space Administration officials, descended at 8:27 IAW Oct. 1, p. 360, to launch site from Ft. Auguste, Calif., at 11:05 P.M. PDT. Five days later, Sept. 28, after a brief delay due to an orbit inclined 22.45 deg. from the equator Peigan in 66.5 Orbit min., sputnik 639.5 m.

NASA described the orbit as one of the best our nation achieved in the Air Force Test Agency B booster combination placed Alouette into an orbit very closely approximating the one intended.

Alouette's principal role is that of a tri-mode missile—in essence the electronic deposits of the atmosphere lies above the polar level of rotation over the polar and several areas of North America. It will also help interpret aurora bursts of ion rays.

By late last week, Canadian scientists expected to determine whether the satellite's solar cells had suffered any degradation in performance as a result of exposure to high-energy electrons released by the July 9 high-altitude nuclear explosion over Johnston Island (IAW Oct. 1, p. 28).

Alouette's apogee is well below the altitude of the July 9 peak, but is only 90 m below the sputniks of the Transit 4B and TOSAC satellites, whose solar cells experienced a 10% loss during the same three July 9 blasts.

Canadian NASA payload managing engineer, S. A. R., who is scheduled to go into an orbit identical to that of S-27, is being delayed to give engineers a chance to change the solar cells due to the more radiation-resistant Nova-P type.

Total ionization from the Alouette satellite as it passed over Ottawa indicated, as expected, that the ionosphere is an efficient reflector of radio waves broadcast from above as well as below it. The satellite was radiating radio signals except in frequency between 1.6 and 1.7 mc.

Depending on ionospheric conditions, some of the higher frequencies went penetrating the ionosphere and being picked up by the satellite after bouncing off the ground. During its first pass over Ottawa, the critical frequency,

below which no signals could penetrate the atmosphere, was 1.5 mc.

Sounding stations throughout Canada and elsewhere were picking the signals of the ionosphere simultaneously with ionoprobe soundings and tapes of return signals are being forwarded for processing by the Defense Research Telecommunications Establishment in Ottawa.

In one exercise conducted from an Ottawa station in the winter past month, the ionoprobe sounders could penetrate readily with 50-watt sounding, indicating peak ionization at that time and location to be about 300 lat.

## DOD Penalty Sought For Security Misuse

Washington—Basic Government Operations Committee, in its latest report on government secrecy, urged the Defense Department to establish penalties for officials who place a security classification on documents for other than security reasons.

"Using security classification places the public's right to know at risk," said the specific rules set up regulation. "If set penitentiary penalties are established for abuse of the classification system, the committee said, 'then penance and humility photons cannot damp the fire that classifications which has no effect on the nation's security is being hidden by as many stamps.'

The committee praised Defense Secretary Robert S. McNaulay's statement, "when is does understand," but said it had little claim when there is absolutely no penalty to prevent secrecy from being used to cover up security rather than national defense issues. A security system which denies no penitentiary for using secrecy stamps to hide errors in judgments, waste, inefficiency or worse is a process of rats' rotivity."

The committee also desired "the lack of an effective procedure for appeal against abuse of the classification classification system." The committee said President Kennedy's decision to handle by "the most lenient means" worst of the job "to have assumed" was not good. Lee C. White, the President's assistant special counsel, said he agreed.

At Air Force test site last week could not identify the exact cause of the mid flight. An AFM crew, reinforced by Air Force Systems Command and contractor personnel, conducted the launch base its operational prototype site here.

added, "any such complaints that may be received will be handled as expeditiously as possible."

"Until a comparable institution in the White House is charged with the primary duty of reviewing and setting up complaints against abuse of the classification system—until a fully operating appeals service is set up and widely publicized," the committee said, "the most important safety valve in the information security system is completely useless."

The committee's recommendations stemmed from an information subcommittee's study of Executive Order 11003 issued Nov. 5, 1953, and changed to safeguard information considered vital to U.S. security. The recommendations did not concern itself with the Defense Department's May 21 directive cracking radiation space activities in secret. Rep. Mohr has asked little or nothing to do anything more than ask McNaulay to provide a detailed version of that directive (IAW May 21, p. 20).

In discussing government secrecy generally, the committee said over the years "there has been significant progress toward resolution of the conflict between the necessity for a full informed public in a democratic society and the importance of protecting defense information to fully preserve that society." The committee paid particular attention of the fact that the new information security system is one which defines very carefully those secrets which are important to the nation's defense and then protects them as carefully as possible."

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## First Minuteman Shot From Vandenberg Fails

Vandenberg AFB—First Minuteman ICBM to be launched here was destroyed by a range safety officer after a 2 sec. flight when the solid fuel booster failed to ignite, causing the missile to abort its climb and fall to the ground.

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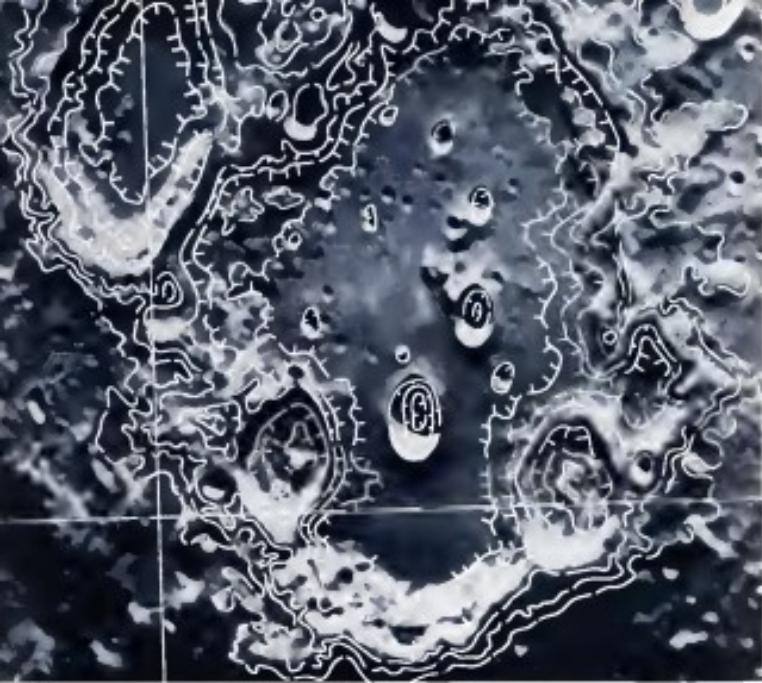
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# Counter-Insurgency Aircraft Plans Studied

By Larry Boos

**Washington—**Plans of proposals from industry to meet current and future requirements for counter-insurgency (CIRN) close support aircraft has descended on the Air Force, Army and the Navy, acting for the Marine Corps. Most are for short takeoff and landing (STOL) aircraft powered by one or two turboprop engines.

The Air Force and Army are examining the probability of modifying existing aircraft for use in the counter-insurgency role. All three services are studying concepts and proposals for new aircraft that will fill the need in the more distant future.

Gen. Maxwell Taylor, who became chairman of the Joint Chiefs of Staff on Oct. 1, is known to favor a concept wherein the counter-insurgency aircraft would perform its mission at low altitudes while protected by an umbrella of an impunity fighters. He has the backing of the Administration.

The most future-oriented counter-insurgency aircraft would be the redesign of the Douglas B-66 and A3D series of aircraft used for bombing the Korean war. The English would be an amphibious, retrievable and land carrying ability. Takeoff and landing speed of 50 to 42 kt. would be necessary for operation from rough airstrips, while the maximum range would be between 75 kt. and 300-400 hr.

The counter-insurgency aircraft would fit the lower end of the speed and altitude spectrum represented by the TX's terminal flights, which will have Mach 2.5 speed and 70,000 ft. plus altitude capabilities, and the VAX lower speed, higher loitering attack aircraft.

But a counter-insurgency fighter based on some existing design is wanted as well as possible. One plan recently released by the Defense Department suggests an insurgency aircraft based on a Republic Aviation Corp. design. Dept. of Defense Secretary Defense Robert Galvin proposed the request on the grounds that an in-production aircraft that will require little modification is needed for the near future. This indicates that Defense Department wants clearer definitions of requirements for its own specific project, for all-new aircraft is appears.

The TX, which is to be developed in separate versions for the Air Force and the Navy, is expected to be operational in the two services in 1967 and 1969, respectively. The TX was in the final stages of a user selection program by Gen. Donald (F) Westmoreland, USA, (West) in April. An F/A-18 has been selected for Navy Scotts and eight Air Force Aggressors, plus the decision by Air Force and Navy needs as soon as

possible as having been finalized in where there is about 15% difference.

The VAX requirements have not been appraised and are not expected to be issued about six months after the TX user selection is made. Since the VAX will be less complex than the TX, user development should not be delayed about four years. As proposed by the Navy, the VAX would be a Mach 1.5 aircraft which would be a replacement for the current Douglas A-4D series.

If the high low aircraft combination concept is adopted it would spell the end of the VAX research in its current form as a future counter-insurgency aircraft and the TX.

As the TX is now conceived, it will weigh 60,000 lb. in the Air Force version and 55,000 lb. in the Navy version. Both will carry 20,000 lb. of stores and will be able to take off at 5000 ft. and climb a 30 ft. obstacle. The Navy version will have an auto landing gear system which can touch down the size of the Eagle-Mars carrier-borne fighters which the Navy now intend to cancel early last year. Hughes Aircraft Co. is developing the module.

The VAX is designed to weigh about 10,000 lb. and be powered by two turboengines. It would carry 10,000 lb. of stores and would be able to take off at 1,500 ft. over a 10 ft. obstacle. The engine capability would give pilots some protection against fighter opposition. Engines can stall but if faster in power would be required to change the speed rights from Mach 1.2 to Mach 1.5.

Defense Department decides to fit the counter-insurgency need around the TX, which is being developed for other defense contracts. One is the Grumman ADF-1 Marauder, now in the process of becoming a two-place reconnaissance aircraft which is not in the Army inventory. The other is a modification of the North American T-28 equipped with a turbo

prop engine, called the RS-28 (AW Dec. 1, p. 21).

The Marauder was originally designed as an STOL aircraft. One model is fitted with self-locking rather than battle damage resistance as all kinds of weather. The other is configured to perform a ground attack mission. It is powered by two Lycoming T-53-L-9 engines developing 1000 hp each. As a counter-insurgency aircraft, it would be fitted with conventional weapons.

The RS-28 (Intruder/corvette) model proposed by North American would be powered by a 2,400-hp Lycoming T-53 engine. The aircraft would be either the Air Force T-28A or the Navy T-28B, both of which have already been modified to the T-2D to perform the counter-insurgency mission in South Vietnam.

Both Air Force and Army are actively evaluating these and other aircraft. At Eglin AFB, Fla., the Tactical Air Command's Special Air Warfare Center is flying the ADF-1 and the T-28D. The Army's 4th Infantry Cavalry Division's Counter-Insurgency Wing at Ft. Bragg, Ala., is in cooperation with the 4th Special Warfare Center, Ft. Bragg, N.C.

The present status of defense efforts is that a counter-insurgency aircraft will perform the sensor duties. They will be the better fighter aircraft with two engines, offering air flow over the wings at high angles of attack and the ability to return to base in the event of the failure of one engine.

The Navy is not acting alone for future counter-insurgency proposals as behalf of the Marine Corps although the Marines are looking into possibilities themselves. The Marines expect to place an order for production of any counter-insurgency aircraft shortly.

Some Army and Marine officers believe that the aircraft used for counter-insurgency in the future should be tested down in size. One source suggests a twin-engine aircraft with each engine developing 500 hp. The customer in fact with an aircraft would be available in greater numbers for covering a greater number of targets, which could be light enough to allow five pilot seats than a larger aircraft and could still maintain most of qualities of larger aircraft.

Defense Department defense counter-insurgencies in all military, political, economic, psychological and ideological areas directed toward preventing and stopping rebellion, terrorism, groups whose members range in degree of violence and range from subversive political activists to violent arsonists to large guerrilla elements to overthrow a duly established government.

# Weightlessness Effects Worrying Soviets

By CECIL BROWNE

Varna, Bulgaria—Soviet biomechanics experts will tell you that the effects of weightlessness over prolonged periods may seriously handicap man's ability to work effectively in space or respond to ground commands by a crew.

Despite the recent successful results of the married Vostok 3 and 4 vehicles (AVW Aug. 26, p. 26), in which Major Nikolai Rukavishnikov and Lt. Col. Pavel Popovich apparently dispensed with imagined tasks without a single problem, critics can see the possible potential effects of long duration in a weightless environment as an important consideration in future space flights.

At the International Astronautical Congress by Soviet Research scientists and Commandant Maj. General Titov.

Report prepared by Soviet Army Col. Vladimir I. Yashkov, a leading figure in the Vostok biostressors program and an associate of the Academy of Medical Sciences of the USSR, concluded that the Russians can be lessening toward the theory held by some U.S. scientists that a prolonged absence of gravity on the body could lead to a form of mental instability and perhaps a breakdown in the body's cellular structure.

Yashkov's report and a "spontaneous" study of the possible effects of weightlessness on man's health were among the Soviet Union's in an effort to determine the determining effects on man, if any, of long-duration periods of weightlessness.

In response to questions, a colleague of the absent Yashkov who read the latter's report at the conference and there that no scientific evidence available to date to confirm definitely the hypothesis. However, Soviet scientists do think a "gradualization of a prolonged absence" could affect man's health but have not subjected to a prolonged period of weightlessness, particularly upon his return into the earth's atmosphere.

He later estimated that this might occur in flights over six weeks, with a possible breaking down of the molecular or cellular distribution within the muscle tissue.

To help confirm that, he said, Russian biomechanics specialists are now studying "all sorts of exercises during a prolonged flight."

Upon their return, he added, Russian physicians planned to check signs of any "physiological damage" on the molecular and cellular levels, and it is difficult to foresee how long a flight would be necessary. "I believe this begins, but generally . . . the more

shorter a cell life, the easier it breaks down in weightlessness."

Major Titov, who suffered periods of dizziness during his 175 orbits around the earth on August 1961 (AVW Mar. 2, p. 114), told delegates in the Congress that Rukavishnikov and Popovich were through a special training program given to their lights. The program was designed to strengthen their vestibular systems, and another refuted from a decade of avance during that respective periods of 90 hr. 27 min., and 73 hr. in space. Titov and Titov's training presumably consisted primarily of a series of physical exercises.

Titov also noted that his Soviet scientists are not yet able to draw firm conclusions as to the effects of weightlessness on man's eyes, possibly extending beyond 24 hr. He said:

"For 24 consecutive hours, the problems of studying weightlessness are not cleared, but weightlessness is still a well-known factor [in manned space flight considerations] and, if we don't create an artificial weight, it is impossible to see when that problem can be solved."

Titov said that while the Vostok capsule has a design-built potential of 10 days, it was decided to keep Nikolai Rukavishnikov for a maximum of four days to investigate the effects of weightlessness toward this relatively limited framework of time.

Rukavishnikov and Popovich, he said, had freedom from the bonds of their life-support system and worked

as independently as possible. Titov said that the temperature inside Vostok 2 ranged from 50 to 60°C (AVW Aug. 14, p. 17). Titov said he was able to cool his body by taking temperature and since "I am from Siberia, I have a 12°C tolerance [during cold]. Below freezing, I regulated it at 10°C."

Generally, Yashkov said, he does not believe prolonged periods of weightlessness will have any long-range effects upon an astronaut at the basic physiological level. "However, as such factors as tissue regeneration, blood chemistry, etc., we are not clear."

Titov had been asked after August 1961, when the meeting originally was to be held, whether an exercise regimen for the fighters and crew members was in possible order. A few days for the meeting has not been set.

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The 1964 Congress is scheduled for Warsaw in the fall, a week after the International Council of the Astronaut and Spaceholds holds its annual meeting there, so that delegates can attend both the IAS and IAF sessions.

Edmund B. Sims of Finsbury was elected IAF president for the coming year due to the maneuver here. Vice presidents are Lemond J. Stiles of Russia, Martin Simeonoff of the U.S., Michael Lemo of Poland and Nicolas Bozell of Belgium.

Titov, in his uncharacteristic appearance at the Congress, and that except for yielding thanks on the problem of weightlessness, each Soviet space flight has a unique profile that escape has done no repeat earlier experiences.

In that regard, he was critical of the first two three-orbit Mercury flights, saying that he could not understand

## USAF Studies Anti-Satellite Systems

All available U.S. satellite models and boosters are expected to be available in the months before being examined by Air Force in a broad study of potential anti-satellite defense weapons under Advanced Development Objective 40 (ADO 40).

If this effort, under the cognizance of Air Force Systems Command's Space Systems Division, continues according to schedule, it is probable that initial demonstration flights would be made by summer time Johnson Island in the Pacific Ocean, Air Force's U.S. satellite targets.

Studies have already considered in the anti-satellite study include Army's Nike Zeus, Air Force's Thor IRBM, Minuteman ICBM and Starbird or low-orbit satellite, and Navy's Polaris submarine launched missile. If included in the program, Starbird would use its proven boost mode from a B-52 mothership plane to take advantage of its orbital launch altitude of about 10,000 ft. Polaris boost mode would be under development.

As far as is preparing to fix the non-maneuver NASA Gemini approach in early or mid-1964 to gain experience in space before the Dyna-Soar boost glider is available, provided the relatives can be issued without disrupting NASA's own Gemini schedule. McDonnell Aircraft, prime Gemini sponsored contractor, is known to have suggested to Air Force's Space Systems Division a military version of Gemini called Eller Gemini, which might be feasible for defense military uses at year.

Starting 1964 as the study program an Aerospace Corp., Rockwell Corp., USAF's Astronautical Systems Division and other government agencies.

why the U.S. waited long repeating experiments after one had been successfully completed rather than taking a step forward or at least in another direction.

He also presented the following brief synopsis from a digest of the mirrored Soviet space flights to date:

\* Vostok 3—Study of the "life conditions" of a cosmonaut during launch, flight and landing verification of the possibility of human life in a state of weightlessness, trial of communications methods to establish pilot communications with Earth.

\* Vostok 4—Verification of the reliability of a long duration of the capsule of a long period of orbit operation, study of the effects of weightlessness on man's flight, verification of the functioning of the capsule's biological systems operation in space for the first time of the Vostok's unusual control unit.

\* Vostok 5 and 6—Study of group flight and rendezvous techniques (AVW Dec. 1, p. 17); length computation of the mirrored control system, including its operation by the cosmonaut while suspended in a chair; a broadening of the range of the effects of weightlessness on all its aspects.

Consequently on the Vostok package the Soviet cosmonauts and provision has been made for safe operation of the space pilot during an ejection on the launch pad as well as after launch. "We have had no way to sit at that but," he said, "we have tested these systems on space ships with astronauts aboard, and they worked wonderfully." These tests apparently included the successful ejection from orbit of the dogs Sharik and Bellka (AVW Aug. 28, 1960, p. 20).

V. I. Mironov, of Moscow's Steklov Institute, has already started working the more

Russian and East European delegations. They prolonged the session with a number of questions pertaining to the neediness of performance capability of their cameras. One USSR put up a shot of an anti-satellite weapon's short and final research technique.

Sergei, in discussing the nation's capability, said that the film from Tiros 5 in August showed the existence of 10 tropical storms around the world. Five of them, he said, were first discovered by Tiros. For the future, Sergei said, the Weather Bureau plans to shoot Tiros to

\* Orbit in a pair U.S.-Canadian ice monitoring program beginning next year, paying particular attention to the movements and actions of large ice in the Gulf of St. Lawrence. He reiterated that such a project will represent a \$1.5-million annual cost going over conventional methods.

\* Detect forest fires by the addition of microwave equipment which can penetrate through cloud and smoke cover to determine the location and nature of the fire. Sergei said the annual loss caused by forest fires in the U.S. is between \$10 million and \$300 million, with another \$40 million going toward the cost of fighting them. Most of this damage, he added, comes from the 1% of the fires that are not detected in their early stages when they would be easiest to control. He and Titov will enough to present a comprehensive program for this purpose.

In all of the light aircraft aircraft in America and Australia, by passing out and photographing the forest clouds themselves and placing that program in the air, the said participants will receive forecasts of the wind patterns which carry the forest fires east at least provide an adequate warning of their approach.

Meanwhile, at the International Astronautical Federation plenary session there appeared at least a glimmer of hope that the Soviet Union eventually may be willing to provide similar with advanced information on one of its future satellites, including planned trajectories and monitoring facilities.

Angus Lovell, president of the Danish Astronautical Society, proposed that such information be of launching cameras "appear to be original." He added that such monitoring activities as other countries "have in some cases been of great value for the launching nations themselves."

Lord 1. Sefor, former IAF president and head of the Interplanetary Communications Commission at the Soviet Academy of Sciences, agreed that the IAF should encourage cooperation in the field, and the matter will subsequently pass on to the agency's executive bureau for study or action.

# Transfer of Centaur, M-1 to Lewis To Advance Hydrogen Research

By Edward H. Koloski

Washington—Reykjavik Atlas Centaur launch vehicle development program has been transferred from the reluctant management of Marshall Space Flight Center to Lewis Research Center, the healthiest competitor for the early research and technology on which hydrogen propulsion for space is based.

National Aeronautics and Space Administration has conferred after a series of top-level reviews that Centaur is the keystone of the entire hydrogen engine development program and has obtained the highest ratings in DOD's technical and production test.

The program shuffle who has resulted is the transfer of the Apollo M-1 upper stage to the Lewis vehicle from Marshall; the M-1 will be developed at a much slower pace than Centaur.

Congress and industry responded favorably because both feel it reflects a decision that will give new life and enthusiasm to Centaur and high energy propulsion. The decision was made despite a recommendation by Marshall that the Centaur vehicle be scrapped entirely and its primary mission—the Surveyor automated soft landing—be shifted to a new vehicle consisting of a Saturn S-1 booster with an Apollo B second stage.

NASA decision by itself Centaur was made Sept. 20 (AW Oct. 1, p. 50) and is based on a belief that the vehicle will penetrate the surface fight effectively. Its success depends on hydrogen-fueled upper stages. Most important of these is the planned Apollo lunar landing, since the Saturn C-5 Apollo launch vehicle has an S-1 second stage.

When asked by Marshall spokesman at the Sept. 28 dinner meeting just what hydrogen engines and stages can best be developed in the S-4, S-2 and S-0 stages, the S-4 is the second stage of the Surveyor-C-1 launch vehicle. Management of these stages remains with Marshall, in fact Surveyor booster development.

Hydrogen fueling at the meeting was that hydrogen technology cannot wait for flight of the advanced Saturn upper stages. First S-4 flight is slated about a year + by which time NASA hopes to have tested three nose Constars. The second Centaur flight test, scheduled for February, is not expected to be affected by the switch in management. First Centaur test failed last May 8 (AW May 14, p. 36).

Future of Centaur has been in question since July, when the Basic Sciences Subcommittee had extensive hearings on the troubled program (AW May 21, p. 28; May 28, p. 32; JWS, 9, p. 3). In its report, the subcommittee recommended that NASA or private Centaur and submit a report on its reevaluation. Detailed report is scheduled to be submitted to the subcommittee Oct. 32.

Major shift in the Centaur program became imminent late last August when NASA's Space Sciences Management Council and NASA's Ames Research Center declassified the program. At that time Marshall's Air Force Division in the past, McDonnell-Douglas' Weekley von Braun suggested at that meeting that the program be killed, the payloads rescheduled and that S-4, S-2B and S-2 be used to develop hydrogen technology. Chief spokesman for continuing Centaur was Edgar M. Corrington, NASA deputy director for space sciences.

Immediately after the Aug. meeting, headquarters, Marshall and the prime vehicle contractor—General Dynamics/Aerospace—discussed to gauge new weight capability figures for Centaur. At that time, as a result of the surveyor launch vehicle, both NASA headquarters and General Dynamics concluded that Centaur can accomplish the Surveyor mission, Marshall said he could not. In its present configuration, Surveyor weighs 3,732 lbs. (AW Oct. 1, p. 50).

Marshall's stand on Centaur has led to the charge that the center is following a "not invented here" philosophy—indicating that if a proposed project does not originate at Marshall, it is not值得 developing. Although von Braun's position on the substitutability of Surveyor vehicles gave confidence to the change, other factors also figured in the transfer decision.

Marshall's head—headlined with Surveyor C-1 and C-1 work and does not have the manpower or resources to continue another DOD program. Conversely, since NASA decided to use the lunar orbit rendezvous technique for the Apollo missions, the Lewis workload has lightened considerably.

Lewis has selected to manage development of the Apollo lunar landing propulsion module, which will be an essential part of the earth orbit rendezvous technique (AW July 2, 1966). When it received this major assignment, Lewis management put forward a DOD proposal. "It's helping with it," he said, "because time all of Centaur has got to work-out necessarily is a setback, but it's a technology."

Assignment of Centaur and M-1

management to Lewis will right the organization, with Bruce Landis, associate director for development, heading the program.

Since NASA was established, Lewis has the primary facility for propagation research in the National Advisory Committee for Aeronautics superprogram. This center began research into electric and high energy space propulsion applications in 1953. Launched at the result of technology developed at Lewis, Air Force liquid hydrogen aircraft and rocket engine research at United Air Corp., beginning in 1957. Defense Department's Advanced Research Projects Agency ordered Air Force to carry a hardware program for the RL-10 hydrogen-fueled engine with United's Propulsion & Weapons Division. During October 1958, ARPA assigned greater responsibility to the Air Force, and, in the same time, the Defense Department made hardware programs for aeronautical and space communications satellite.

Centaur responsibility and funding shifted from ARPA to NASA July 1, 1959, but NASA retained ARPA as project manager and contract administrator until January 1967. Marshall's reduced management began in June 1960. Lewis propulsion experts remained on the periphery of the program throughout its development, following which continued through Jan. 1 (AW Oct. 1, 1966, p. 26; Oct. 27, 1966, p. 12). A team from Lewis was called in to review the design to troubleshoot the program, particularly while static tests started in their explorations during the winter of 1960/61.

In its hearings, Congress was critical of what it considered inadequate program management of Centaur, with technical management done in a total staff of 15 until mid this past January.

Since the Centaur Advanced Mission has been canceled (AW Jan. 18, p. 12), NASA's strong objection of the new few years on test flights, in order to obtain fundamental knowledge on hydrogen technology. Marshall had a considerable man-power increase available from Surveyor, since the communications satellite flight called for three separate hearings of the Centaur stages: two regular and extremely long cycle between them to attain the 22,000 lb. thrusts of orbital altitude. Surveyor did not require that type of performance.

Rep. Joseph E. Kort (D-Minn.), chairman of the space sciences subcommittee, told Aviation Week at a "closed" hearing last week that NASA's decision is timely. Centaur and accelerate the program with a DOD proposal. "It's helping with it," he said, "because time all of Centaur has got to work-out necessarily is a setback, but it's a technology."

# Government Is Pressing for Early IAM-Aerojet Strike Settlement

Government is pressing for settlement of the International Amalgamated Metal Workers Union and St. Louis Aluminum Co. plants in Alton and St. Louis, Calif., late last month, by bringing union and company management together in Washington. Federal Mediation and Conciliation Service is handling the file. Settlement of Labor W. W. Winkle was pending for six weeks.

Possibility that President Kennedy might invoke an 80-day cooling-off period under the Taft-Hartley Act loomed at Alton in the case the dispute was not resolved swiftly. Earlier in the week Winkle had pointed that the strike called last Tuesday is postponed to the interests of national defense. About 10,000 Alton employees are involved, 8,000 at Alton and Sacramento.

Union membership reported yesterday it will offer peace to the Alton plant.

The other option is to bring the parties of several atomic weapons armament to several major weapon complexes. It would be a wage freeze totaling 25 cents per hour in increments over the fiscal year of the proposed contract. The IAM local would a 25-cent cut in wages immediately, a one-cent cut in the next period and an additional increase, in the number period. Also, there would be a union demand that Aerjet for each participating party to those now parties where a union just announced IAM is represented.

The option of a seven day, in the last four days of unmanaged wage increases throughout the acceptance date, is not an option of the Alton plant, since the union does not affect more than 30%. The union has not proposed demanding the acceptance. An iron strike agreement requires that all eligible employees join the union before a specified period after their employment.

Negotiations between Lockheed Aircraft Co. and IAM continued with little sign that the company was looking down on its refusal to accept a proportional methods parity arrangement of a union shop should be ready of eligible employees voting in a special election annuity it.

The IAM demanded a threatened strike at Lockheed although it is free to go for a 14-day written notice of strike at any time (AW Oct. 1, p. 27).

Another option being worked out will be conducted by the National Labor Relations Board at three other major St. Louis defense aerospace companies during the next week. Under separate agreements between the various parties, contact by two-thirds of those casting ballots is necessary to make a union

Electoral Workers over the status of 40 nonunion workers (AW Oct. 1, p. 27). National Labor Relations Board scheduled a hearing on the dispute last Tuesday, but it was postponed indefinitely. There is no minimum wage requirement.

• Assignment to Bell Aerospace Co. and Local 207 of the American Federation of Telephone Engineers as a 25-cent contract covering 120 Bell telephone who staged a 10-day strike Sept. 24. Contract provides for an immediate 10% wage increase retroactive to April 19, and 3% raises in April, 1967 and 1968.

• Announcement by General Electric Co. that in April it will begin laying off 1,000 employees, working on Polaris Guidance, from its Guidance Department in Pittsfield, Mass.

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## News Digest

Federal Aviation Agency has awarded two contracts totaling \$175,000 for design and production of Type I attitude-reporting transponder beacon for light aircraft (SLATE) to Tassan Products Inc. and Hercules Technical Development Center.

Titan communications satellite transmitted digital coded data from England to the U.S. last week. The rate of 875 bps has been raised to 1,000 bps, about 3,400 words per minute. The 4-week compression multiplication will participate in Triton trials to demonstrate transmission communications between business machines.

Western Electric Co. has received a \$14,976,441 follow-on contract from Army extending research and development on the Nixie Zinc-Antimony RCME until December.

General Dynamics/Aerospace will receive a contract soon for option March 31 Standard Space Launch Vehicle version of the Atlas D rotatable Air Force's Space System Division. Contract will total about \$70 million.

Riddle Airlines' top management was strengthened last week with the election of James B. Franklin as president and chief executive and James H. Cawthon as chairman of the board of directors.

Edward H. Henneberry, 30-year veteran of the aerospace industry, has been elected a vice president of General Dynamics Corp. During 35 years with the Douglas Aircraft Co., he had been known for his contribution to the development of many aircraft. His most recent had been executive vice president of Guidance Technology

# AIR TRANSPORT

## Witnesses' Fate Debated in Safety Probe

Halsky would prosecute stewardesses who admitted flying airliners; Rep. Brooks opposes punishment.

By Robert H. Cook

Washington—Congressional probe of air safety violations, highlighted last week by new photos and testimony alighting officers by airline crews, is testing on the difference between a set of circumstances and a set of outcomes.

Rep. Jack Brooks (D-Tex.), chairman of House Government Operations subcommittee, is opposed to punishing pilots or stewardesses whose violations were done to light during the hearing, or the flight engineers who sabotaged photographs of the alleged violators on Eastern and Trans World Airlines (AW Sept. 24, p. 47). Brooks contends his goal is to eliminate such violations and prevent "14 million Americans from being guinea pigs" in an inquiry.

Rep. Joseph F. Halsky, administrator of the Federal Aviation Agency, questions the validity of the accusations, but has threatened to prosecute two witnesses who admitted that unauthorized piloting of aircraft several years ago, and plans to submit the relevantious areas of portions to the legal Board of Regents for "authentication."

Any pilots identified in the photos will be examined by the FAA, he said, but the agency has no interest in grounding any pilot for "making a nap five years ago."

The administrator and FAA had invited sufficient testimony to detect and punish those who deliberately ignore regulations, but have given no power to ensure that violations of enforcement rules, available to the government under its present authority, FAA is powerless to prosecute those who fail to come forward with evidence as who willfully destroy such evidence.

Rep. John E. Mica (D-Orlando) a subcommittee member, has given strong support to Halsky's views through his questions and statements during the hearings. He has been highly critical of the flight engineers' conduct in refusing the photographs, and has questioned their motives.

Mica and last week that William J. Miller, a TWA flight engineer who made the famous photo displayed to the committee, did nothing voluntarily to help air safety, "unless he failed to perceive the evidence of illegal manipulations and subversion by Congress." Miller had testified that he withheld the pictures because he had been threatened.

Miller also objected when Brooks entered into the record several letters from the public condemning the investigation and citing other alleged violations. Brooks said it was "irreprehensible

he" that most of the letter writers found it necessary to acquire a scholarship before they could begin to light a cigarette because of fear of reprisal.

The investigator has gone beyond his original purpose, since Brooks has also taken the opportunity to dig into FAA's role in the Air Line Pilots Association and Flight Engineers International Area Traffic Control of the third seat on board aircraft. He has particularly questioned Halsky on why FAA favors the current doctrine of pilot qualifications, as opposed to mechanical, as a prerequisite for flight engineers or mechanics. Brooks reminded Halsky that the presidential election, the Air Force Navy and even the FAA are long-term areas of concern to flight engineers with a mechanical background.

Halsky responded that these admissions were what he was doing in FAA administration, and that he was not responsible for the violations. Brooks said, but if Halsky assisted, he might face each witness \$2,000. This is the same amount that FAA levied against Eastern recently for each round of operating an aircraft not approved by FAA inspectors, Brooks explained.

Other witnesses told of other cockpit violations, including one case in which a captain and copilot continuously placed cards on a Western Airlines night flight between San Francisco and Portland. The witness—unstated—and that when he asked why, the interior cockpit lights were turned up so high that it was difficult to see outside, the captain had him turn everything down to a dim level since "we're so off course that we're going to end up in Oregon."

The high point of last week's testimony was the display of more than 100 cockpit pictures taken by Miller. Most depicted pilots either sleeping or reading while at the controls. Several showed hostesses at the aircraft console while seated in a pilot's lap. All

Brooks replied that if FAA felt a strong technical and mechanical background, such as required by the Air Force and others, is not necessary for commercial airline flight engineers, the engineer "should be fired" rather than conduct an examination on the pilot's part, employing the flying public in "guinea pigs."

Testimony from several former air line stewards who either witnessed other stewardesses "flying" or assisted the stewardess at the controls, or who admitted having done so themselves, later triggered a sharp exchange between Brooks and Halsky.

Miss Margaret Swann, a former Pan American World Airways hostess, described how, in 1955, she had flown a scheduled airline flight for Pan Am, during which she was the aircraft's co-pilot, and then had to altitude. Another stewardess, Miss Margaret M. Dowd, told how she was flown on Eastern Air Lines Constellation from Newark, N.J., to Charlotte, N.C. She said she sat at the controls, mostly 40,000 feet, during which the aircraft descended from 10,000 ft to cruise altitude to 3,000 ft before she left the controls. It was such a "thrill of a lifetime," she added, that it might not be possible to improve on new stewardesses that the airline offered.

Halsky's reaction to these admissions was that there was no proof found in FAA administration that any of these women, for the violation. Brooks said, but if Halsky assisted, he might face each witness \$2,000. This is the same amount that FAA levied against Eastern recently for each round of operating an aircraft not approved by FAA inspectors, Brooks explained.

Other witnesses told of other cockpit violations, including one case in which a captain and copilot continuously placed cards on a Western Airlines night flight between San Francisco and Portland.

The witness—unstated—and that when he asked why, the interior cockpit lights were turned up so high that it was difficult to see outside, the captain had him turn everything down to a dim level since "we're so off course that we're going to end up in Oregon."

The high point of last week's testimony was the display of more than 100 cockpit pictures taken by Miller. Most depicted pilots either sleeping or reading while at the controls. Several showed hostesses at the aircraft console while seated in a pilot's lap. All



Soviet Il-62 Uses Aft Engine Mounting

This photo of Russia's giant Il-62 jet transport shows general similarity to Western jets using air reverse mounting, particularly the Viscount XV-10. Il-62, however, is longer, with different geometry. There are other passengers and crew flying. Propellers are in upper half of Il-62's fuselage, lower engines being on wings, smaller wheels and a gear extended to upper deck to allow easy food delivery. Diesel engines have base of vertical flaps near large engine nacelles in lifting, lifted vehicles. Main landing gear wheels, with low wheels stick, apparently fold into fuselage as on Boeing 707, indicated by absence of wing gear bearings like those of Tu-104. Designers longer fuselage also extended the trailing edge wing flap. Wheel base along the fuselage prior to engine mountings, probably resulting more uniform surface as far rear. Right on lower side of fuselage beneath engine was not exploded. Four engines are 21,000 lb thrust. Larger packages dropped by N. D. Kourkine. Plane is designed for still high cruise in long nonstop flights. (AW Oct. 1, p. 29)

means of identification such as flight numbers and the facial features of the new members had been carefully cut out. Miller said he had learned the negatives and that the prints submitted to the subcommittee were the only ones in existence.

Referring to one portion of the subcommittee's testimony based on the log of a copilot, Miller said the girl was "under constant pressure" from the captain and had to comply with the wishes even though they may be incorrect.

Miller estimated that this type of violation had occurred on 75% of the TWA flights on which he had served. In one particularly tragic episode, a doctor was shown missing from a passenger compartment of a TWA aircraft. Miller and the captain had performed a visual inspection of the cabin, the doctor was not found. The doctor died shortly after the plane landed because drunk and bare feet of the aircraft seats froze those mornings. The doctor remained home, and during a descent started to die through the door to the cockpit. Miller said he was forced to hold the door shut with his foot to prevent the man from breathing fire and hitting the control.

Miller said he took 250 such passengers between May, 1957, and June, 1961. At the conclusion, he had approximately a third and tenth as depicted by the aircraft instruments in the cabin. In addition, Miller gave the subcommittee a stack of index cards which he had and were a record of other violations he has

witnessed since he ended his photographic project.

Miller explained that he, like Eastern flight engineer D. K. Casper, had used an infrared camera in a black box mounted on the side of the cockpit panel. With the aid of a left extension cord, Miller said, he was able to take pictures without leaving his post.

The actress was first shown in Warren Lee Person, then heard about Anna at TWA, in 1959. Miller and Person asked the flight engineers to "discuss" and later suggested that they show them to the subcommittee's investigating committee. Requesting that idea, Miller said, he later brought the matter to the attention of TWA's senior engineering vice president, but got no results.

Finally, a responsible FAA official was shown 50 of the photographs, but still nothing, Miller said.

Halsky replied that the officer, Philip N. Goldstein now in FAA's Flight Standards Service, was then a Civil Aviation Board accident investigator. Goldstein concluded he never saw the photo, and was not fully told of them either, said Miller. Halsky and Goldstein was instructed to CAA to accept Miller's "conditional offer of evidence," Halsky miffed. Miller reported to the subcommittee that he had actually shown the pictures to Goldstein.

First general knowledge of the previous disclosure by AVIATION, October 16, 1961, p. 21, resulted in two threatening telephone calls to his house and winning of legal action by ALPA if Miller did not drop his photo project.

Halsky also urged Miller to discuss the legal ramifications with FAA further and presented to CAA TWA President Charles C. Tilghman to plead for Miller's clemency availability letter.

Brooks earlier had assured Miller that Tilghman has given his word that no action will be taken by the airlines against the flight engineer who has been granted to travel media because of an other violation.



## Tomorrow's supersonic engine is flying now!

The British Siddeley supersonic Olympus is now undergoing flight trials in a Vickers Flying test bed. This engine will power the BAC standard transatlantic/transoceanic aircraft—TSAI 2, which will have a speed in excess of Mach 2 and is due to fly in 1965.

A small version of the supersonic Olympus is also under development and is ideally suited to the requirements of Mach 2 transport aircrafts.

As powerplant of the Avro Vulture V-bomber basic the Olympus has proved to be one of the most reliable large gas turbines in service.

The Olympus 301 has recently completed an official Type Test at a thrust rating of 26,000 lb and a more advanced version of the engine has some reversible time being achieving thrusts in excess of 30,000 lb with refuelling on the test bed.

### BRISTOL SIDDELEY ENGINES LIMITED

BRISTOL SIDDELEY AVIATION LTD, FARNBOROUGH, HAMPSHIRE, ENGLAND  
BRISTOL SIDDELEY AVIATION LTD, WILTON, NEW YORK, U.S.A.  
BRISTOL SIDDELEY AVIATION LTD, MELBOURNE, AUSTRALIA  
BRISTOL SIDDELEY AVIATION LTD, TORONTO, CANADA

## Canadians Balk U.S. Carriers' Try For New Bilateral Discussions

Washington—Folios of Canada's Air Transport Board is seeking cancellation of service to Toronto by two U.S. carriers, Pan American and Trans World, and will make its decision before the end of November. An ATB spokesman says part of an extensive campaign by Canadian carriers for greater protection rests on this issue.

Trans Air Lines has been trying to shake off its place as a Toronto-Buffalo-Pittsburgh-France carrier that winter and American Airlines has been unable to transfer its Toronto-Buffalo route to Midway Airlines because of the delay which Air Transport Board (ATB) members believe was inevitable for several more months.

Authorization for the route is contained in a 1959 bilateral air agreement between the two countries, and the Civil Aeronautics Board of December 1960 directed it to negotiate the route in the interest of CAA, and to maintain the quality of Canadian-American service between the ports to Midway.

Canadian observers believe Canada is using the European application as a political wedge to force a re-opening of bilateral talks. They point out that this type of application in the past usually has been handled with dispatch by the Canadians in a matter of weeks, often over several months.

In contrast, they point out, Batavia applied in February, expecting a quick approval, but was informed that the Canadian ATB was conducting holding hearings on the matter—a procedure only completed in the past

### Northeast Credit

New York-Cost Assessment Board has reported a \$3 million revolving credit agreement between Northeast Airlines and Chase Manhattan Bank set to expire April 30, 1963.

Under the agreement, Northeast can borrow the difference between its cash on hand and whatever it needs to cover overhead operating expenses. Repayment is due at two-week intervals, but only if Northeast's cash on hand exceeds 10 days' total operating expenses. If not, Northeast can add the cash to its debt, provided it doesn't exceed \$15.5 million and leaves no surplus.

Northeast will borrow \$2 million to pay off an earlier \$1 million revolving credit loan from Chase Manhattan (AW, Jan. 13, p. 4), and an additional \$1 million to pay installments on equipment debt now in arrears. Higher Total Cost covered the loan with \$4 million to TWA, interboarder finance debentures and about 180 acres of unpatented land.

Eastern is still waiting for a answer. The ATB recently advised the airline that it would not open the option to terminate its service to the two U.S. carriers until November 15. An ATB spokesman added that public comment has been invited, and that it would expect to see the new service in action, a final decision will take much longer.

Trans-Canada Airlines, which operates a Toronto-Toronto morning service, has already filed an objection to the application on grounds that she added U.S. competition is not needed and that the 1959 bilateral agreement has not affected an equal penetration of U.S. markets for Canadian carriers.

The CAA's earlier last year noted that the mandatory stages at Buffalo and Pittsburgh were being planned as the Eastern route to avoid the possibility of undue competition with TCA. But figures show TCA carries the vast majority of Toronto-Toronto passengers.

State Department spokesman and two Canadian government officials discounted the bilateral agreement last year but came to no conclusion. They have suggested reopening the legal negotiations several times, but the U.S. is not prepared to take such action until after the "full negotiation" of the White House international air transport policy study (AW Oct. 1, p. 26) have been studied, he said.

CAA spokesman also noted the Canadian insistence on new bilateral rules, and pointed out that while Canada contends it has not imposed unnecessary restraints from the route exchange, it has come up with U.S. border powers in Cleveland, triple profits by Montreal, service to Europe to Manila, and what the Cleveland airport was granted TCA, he said. It was not mentioned that it would be outlined in more detail in the agency's typically lengthy and meandering memoranda.

In a speech proposed for the Air Traffic Control Admin's annual meeting here last week, Holmes said that about \$8,000, "a random type of options credit" had concluded. Depending on the number of negotiations and available Area above 45,000 ft, he said, this would lead the U.S. more readily to the industry's typical "no comment" policy.

Holmes also suggested that the future of the PA/AVIACOM/CAAC/ATC to establish an independent Federal Aviation Service, a group composed of en-traffic controllers who could be permitted to serve such expandable "border points" as Seattle, Denver, Cleveland, Chicago, New York City and Boston. In contrast, U.S. carriers still sit at major Canadian cities, he continued.

U.S. airlines say that while about all major Canadian cities has been granted, most of them possessive carriers are themselves "border" cities in Canada. Because these ports are a long way from each other, it would be required to fly from one to another, as in Mississauga or Toronto, via Ottawa, or from Montreal to Quebec City or Gaspé. The cost of the fuel required for such flights is prohibitive.

### TWA Doppler Flight

New York—First nonstop flight using Doppler radar instead of a primitive searchlight to measure clouds was performed last night by Tom Wilson, TWA Airlines Boeing 707-318, with 125 passengers and 12 crew members aboard. Departed Newark at 9:45 a.m. EST and arrived Louisville at 9:39 p.m., an enroute ahead of schedule.

TWA has harbored 17 of its 51 aircraft with the adoption of Doppler on overcast routes, the equipment being operated by the pilots. Eighties enroute acceptance will work on interim patrol schedules.

## FAA May Eliminate Middle Airway Level

Las Vegas—Middle level of the U.S. transcontiguous airway system, which extends from 13,000 to 24,000 ft, probably will be eliminated in response to pressure not to use traffic controller complacency, FAA Administrator N. R. Holmes said.

Under a plan being studied by the agency, the floor of the high altitude, no man's-land structure would be lowered to 18,000 ft, and the low altitude ceiling would be raised to 24,000 ft. The proposal was first made by Holmes in his speech to the National Air Traffic Controllers Association in Las Vegas on April 13, 1961, p. 43. He moved it to ease the problem of rapidly increasing traffic over airports, especially in another—a maneuver that often involves changing an aircraft's speed with respect to its relative airspeed.

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•**Passenger**—But controllers are restricted to use in communicating with pilots probably will be simplified.



"Next  
morning"  
delivers...  
  
across  
an  
ocean  
  
or  
continent

When the new Boeing 707-300C cargo jet goes into service next year, it will offer shippers "next morning" delivery of volume freight—across an ocean, or a continent. For the first time, an cargo will move in volume at jet age speed.

The 300C will carry more than 60 tons over a range of 5,500 miles. Its cargo door is the largest on any commercial cargo aircraft. A loading and unloading cycle of a full cargo payload on pallets can be completed in less than one hour.

The 300C's upper deck is readily convertible to all-passenger, all-cargo or combination configurations. Conversion from all-passenger to all-cargo configuration, for example,

requires only four hours. A total of 100 economy-class passengers can be accommodated, or 66 in Military Air Transport Service-type seating. Cruise speed with full payload is 575 miles per hour.

The 300C is a development of the famous 707-300B Intercontinental, the longest-range jetliner flying today. It incorporates the major systems and components of the 300B, thus providing operators the many savings advantages of standardized spare parts, ground handling equipment and training.

The new 707-300C has already been purchased by two customers, Pan American World Airways and World Airways.

**BOEING CARGO JET**

## TWA Considers Heavier Regional Service

By James R. Arkle

New York—Selling as hard as a canister of aspirin and applying more world records to flight schedule planning are key parts of Trans World Airlines' new management philosophy.

The change is expected to result in TWA shortening some transatlantic nonstop frequencies, a faster regional service, plus more nonstop flights in 1985 between New York and major European business centers such as Geneva, Milan and Rome.

TWA officials said consideration is now being given to changing TWA's advertising policies, where we are making the people we see look better, and more seriously. We're talking about nonstop flights that stopped out, a feature I deplore."

Largely responsible for the shift is Thomas S. McFadden, vice president of marketing, who joined TWA in July after a promotional career with the National Broadcasting Co.

"I know many in the industry would say what TWA was up to, bring a radio and television crew for airline sales work," McFadden said. "But you'd be surprised at the similarity between all our programs to upgrade and refine sales to passengers."

### Sales View

McFadden's view is that an airline just isn't like a lot of broadcasting franchises. "You either sell a radio or you lose the revenue from it," he said. "There's no stock inventory; you can't reduce the price before the new model comes out."

McFadden feels the airlines, fighting among themselves over a set number of air travel slots, are in the same position as broadcasters, who are the same number of stations and have the same availability of top program sponsors to choose from.

"We finally attracted some attention by improving our product," that is, upgrading the radio and television networks, he said. "Now, we're trying to do the same thing with the sales business, making it acceptable to more people."

New considerations under McFadden are the formerly separate departments of scheduling and market development, thereby taking older and planned a united effort.

"The angle was to begin tailoring our scheduling and customer service according to the changing nature of the airline market," McFadden said.

McFadden says there has been a definite lack of aggressiveness in airline sales. Under his direction is a new staff of five vice presidents who McFadden feels will inject more enthusiasm into the sales effort.

Victor H. Herold is now vice president and general sales manager. Former general manager of Eurowings Airlines under TWA's management, Herold is counted with that carrier, himself, as responsible for the success of TWA's sales programs throughout the system.

Asst. Gen'l R. Roede, formerly assistant vice president of equipment planning and development, has been promoted to vice president of scheduling and market development. J. N. Martin was brought from a New York dairy plant to become vice president of passenger sales. S. C. Thieling, vice president of cargo sales, and H. G. Reigert, vice president of advertising and sales promotion, complete the staff.

### Market Research

McFadden will rely heavily on market research in determining sales programs. His initial move was to intensify selling efforts in the four major markets—Chicago, New York, Los Angeles and San Francisco—putting sharp patrols in a dozen reporting hot in Herold.

"But we must get into the area of what was once called the 'blue collar' trade," McFadden said. "That's where the money is today. We know that class has dollars to spend on air travel if we can convince them to do so."

He said TWA will not ignore the bottom tier travel, who represent 95% of all air travelers and generate 75% of TWA's repeat business. TWA is also taking care of the expensive-market traveler through its Business Concierge service on Concourse 300A, and as Concierge Special whereby it will send midairline concierge and executive service in any city at the traveler's request and expense.

"One issue that is attracting business outside the expensive-market is a straight vacation package," McFadden said. "We know the sun exercise clubs are a good idea, and each year, because of OPEC's love to attack the country, this membership and executive entertainment expense may add intensity in management circles."

### Travel Expenses

"The challenge is to get people to analyze their overall travel expenses," he said. "And they will see that they can go as extravagantly by air as by surface in many cases."

McFadden says selling, not implying but cutting at greater fuel per gallon is in his estimation, the way to expand the market.

"We're reexamining changing our advertising to make the passenger shows look more like regular air fare

shows," he said. "We know that many people don't fly simply because they've decided from past cost that they can't drive like a Madeline Aviation executive in a Hollywood action."

Airline markets are "so determined and tapped in the way they think non-businessmen and other community distributors do it," McFadden believes.

"We're going to begin a concentrated travel program, taking in specific industries and population centers," he said. "For example, look at the electronics industry. It is scattered all over the country."

"We'll determine the travel patterns of people in this industry, where and when they want to go, and then pitch our rates and schedule approach to meet the need."

Frederick D. Hall, TWA's senior vice president and marketing director, says the airline is developing a broad-based atmosphere about the airline market. He says there are two schools out that you can generate business, the other that the market is static.

"We're competing the idea that you don't generate business," Hall said. "This is the view that has led the industry into fighting over a lot of customers."

### Potential Business

Hall and others have been too much attention devoted to the larger offices and to transcontinental marketing markets. He wants to find out how much potential air business there is in other cities, like Cleveland, Cincinnati, St. Louis and Denver.

"No airline exploits these areas, or seeks new business in them," he said. "But to achieve continuing market growth, we must begin better service for all the cities in which we operate."

Hall said that if market analysis proves TWA can compete more effectively than the other three highly competitive markets, then it will set up additional programs designed to serve those areas better. He considers that TWA might have to reduce its transcontinental and nonstop frequencies to reflect aircraft for such a move.

McFadden and TWA's money forest will go to radio sales and analyze the salary, income and travel characteristics of the population, resorting even to blackly-black doublet singing when necessary.

The prime incentive for big sales force, easier, is also being designed by McFadden in fixing up TWA's field representatives.

"There are few in our sales group who are really aggressive men who will go out on weekends or speed as ev-



# Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company



McDonnell Douglas VZ-10 aircraft. Right: Ground crew members show several methods of landing gear operation. From left: gear down, nose gear down, nose gear down; nose gear up; and lift-fan inlet closure doors are all in open position. Air force.



VZ-10 control lever. Neutral pitch control. For normal flight, a left control stick similar to those in helicopters that isn't has been added. Arrows indicate how vertical tail lift-fan inlet closure doors are all in open position. Air force.

## GENERAL ELECTRIC-RYAN UNVEIL LIFT-FAN POWERED VTOL VZ-11

RAM JERROD, Calif.—Final design of the U.S. Army's VZ-11, world's first lift fan VTOL aircraft, was unveiled recently by the Army at the Ryan Army aircraft plant here.

Also shown was a full-scale VZ-11 model, demonstration of the advanced technology involved, which will be flight tested next year. General Electric is prime contractor to Ryan for the aircraft in charge of designing and building the aircraft.

Fight testing of the VZ-11 is expected to begin Aug. 3, a confirmation that lift fan propulsion can proveably solve design requirements for many future VTOL aircraft. The system produces twice as many thrust than the current VZ-10, a lift fan aircraft with available engine thrust by 300 percent. Hence, the base engine can result in more efficient flight conditions but not necessarily to meet certain flight requirements.

The major advantage will make possible significant savings in fuel consumption and logistics support, and provide greater safety and payload capability. As a result, the VZ-11 concept is unlike typical VTOL aircraft in that it is designed to have performance which clearly exceeds existing capabilities. Requirements for military missions.

The Army feels the VZ-11 aircraft can be used for a variety of combat roles including assault, transport and general use. The VZ-11 concept blends battlefield mobility with high performance. It will be capable of taking off vertically, transitioning to conventional flight, and will

### Rocket Case Contract Won

CINCINNATI—Clem. Chmelar, Vice President of Defense Systems, General Electric Co., recently awarded an \$81.7 million contract to Thermo Chemical Corporation for uncontracted production of first stage rocket motor cases for USAF's Minuteman IRBM.

As part of its recent awards of \$11.4 million for 1982 production, the new contract will cover production through 1985. The rocket cases serve as the main structural members for the missile's first stage.

### Machining Breakthrough Predicted Superior to Conventional Metalworking

CINCINNATI, Ohio—Electrolytic machining techniques developed by General Electric for manufacture of metal jet engine parts and rocket motor cases may revolutionize conventional metalworking used to make many aerospace components, company officials predicted here recently.

Developed initially for drilling holes in the high-temperature alloys used for jet engine nozzles and blades, electrolytic machining will be able to produce vertical feedings with a single impact. Conventional feedings can be made with a single impact but only by bending cutters.

The main advantages of the new technique over conventional machining are the ability to machine faster, at higher speed and longer tool life. With conventional methods of tapping or drilling, the chips fall off at the surface of the workpiece increases. But with electrolytic machining, there is no appreciable contact, whatever the material, as long as power input is constant.

General Electric is currently making known to the U.S., England, France, West Germany, Japan and Italy its new electrolytic machining equipment using the technique preferred during a five-year development program.

## G-E CJ610 Turbojets Boost STOL Capability of Fairchild C-123H

HOLLYWOOD, Calif.—Flight tests of Fairchild C-123H equipped with two new mounted G-E CJ610 turbofans are completed here recently in an accelerated effort to provide the transport with STOL capability.

Fairchild hopes the C-123 will help prove the C-123's capability as an intense RTOL transport in the 10,000 pound pay load state.

Under current procurement schedules, advanced aircraft systems cannot be available until the 1986-88 period when Boeing Helicopters' KC-135 and McDonnell's Cessna II become operational. Meanwhile, the only operational STOL transport is the Convair AE-2, which is limited to 2,000 pound payloads.

In addition to conventional flight test, one of the two C-123 installations, including engine, avionics, pod, and pyro, will be shipped to the basic weight of the C-123H.

Developing 3500 pounds thrust, the CJ610s were being tested below the wing, instead of the rear centerline. The rear centerline installation was selected because of engine cooling, and sections of booms that must swing.

To gain against ingestion of rocks and dirt, built up flame arrestor reversing bullet-like valves and the main gear jet installed automatically. After engine is started, the torque valves open and are engaged with a switch to the rear end.

Shorter flight testing at Fairchild's Memphis, Tenn., plant, the C-123H shows significant improvement in take-off and landing distances normally associated with the conventional version of the aircraft.



JET-POWERED, this C-123H was recently equipped with two General Electric CJ610 turbofans. Fairchild reports significant reductions in takeoff and landing distances.



THESE XB-79 TEST PILOTS from North American Aviation and the Air Force charity accepted the responsibility of flying the first XB-79. Left: Lt. Col. John Coffey, USAF, and USAF Major Gen. Robert F. Johnson, Commandant of the Air Force Test Pilot School. White's fellow XB-79 pilots who attended were USAF Maj. Col. Joseph Coffey, test pilot; and USAF Maj. Col. Robert F. Johnson, Commandant of the Air Force Test Pilot School. Right: Lt. Col. John Coffey, USAF, and USAF Maj. Col. Robert F. Johnson, Commandant of the Air Force Test Pilot School.

## Ring of G-E Jets to Power CG&E Generator

CINCINNATI, Ohio—An unusual new

use for aircraft jet engines is the

new generation of the

GE aircraft jet engines.

The CJ 610s will be slightly modified versions

of the CJ 805 turboprop powerplants.

Conversely, the 19 light

jet engines will be converted to

power CG&E's generator.

Arranged cylindrically, the 19 light

jet engines will be connected to a

CG&E's 100 megawatt

generator, equivalent to the

GE 300-3000 powerplants.

The GE aircraft jet engines will use the new

air to water heat-exchanging power

plants on dual and seasonal peak loads.

The CJ 610s for the new powerplant will be slightly modified versions

of the CJ 805 turboprop powerplants. CG&E 300-3000 powerplants now in service

with domestic and overseas carriers. The GE aircraft jet engines will be converted to powerplants equivalent to the

CG&E's 100 megawatt powerplants, equivalent to the GE 300-3000 and ASJ

and USAF's F-117A and B-1B.

The new powerplants will run on GE aircraft jet fuel, which is an extremely clean, low-sulfur, jet fuel.

A separate control system will be used

to regulate the aircraft jet engines and the auxiliary power unit and the third section, a stabilization ship.

## FOR MORE INFORMATION

If you would like additional information on these jet powerplants or programs, write us at your company's International General Electric Company, Route 208-22, Schenectady, N.Y. 12340.

*Progress is Our Most Important Product*

**GENERAL ELECTRIC**



**This quiet revolution in components**  
*vitaly affects your avionics equipment reliability*

Without benefit of fast gate the electronic vacuum tube has greatly aided increasing gains in reliability over the gas diode. Data accumulated from 1953 to date on Syplex Gold Brand Subminiature Tetrode reveal an impressive decline in percent failure rate—say, on average of 3.5% / 1000 hours as approximately 0.2% / 1000 hours.

Complied under pharmaceutical excipient prior and across dimensions and once-reach high absorption. These figures demonstrate that Vionate tablet provide both high performance and high reliability.

more severe than encountered in actual field usage. Double peaks of about 500g, fatigue limit of 2.5g for 90 hours, bulk temperatures of 165°C. Large samples are held tested under high temperatures for 500 and 1000 hours. In all, Sylvac Gold Bonded Tubes are built to ensure dependable operation of your electronic "guns and cars."

If *anisotropic* reliability concerns you, be specific about the components you use. Make certain they are single-quality electronic tubes—look for the Sylvane GB Gold Brand marking on the tube. A complete list of GB Gold Brand types, and prototypes, is yours for the writing. Electronic Tubes Division, Sylvane Electric Products Inc., 1180

AVAILABLE FROM YOUR SYLVANIA INDUSTRIAL TUBE DISTRIBUTOR

# SYLVANIA

GENERAL TELEPHONE & ELECTRONICS

TYPE-OF-FLIGHT	TAKING-POSSESS AIRCRAFT GROSSWE AND SERVICE UP TO 31 DECEMBER 1967*					
	Entered		Retained		Remaining to be delivered	
	Before 1961	During 1961	Total up to 31.12.67	Before 1961	During 1961	Total up to 31.12.67
BUSINESS						
Boeing 707	182	49	231	148	14	162
720	80	35	125	29	65	70
Cessna T440 (M60)	30	-7	23	—	—	30
Convair 880	48	11	59	100	23	123
Douglas DC-8	187	—	187	13	56	50
Cessna 441	55	5	60	42	12	57
Cessna 440	928	62	982	66	57	95
Convair 880-10	40	4	44	—	—	44
De H 121 Trident	29	—	29	—	—	29
Hawker PEP	88	27	117	—	—	—
RAC 111	—	16	16	—	—	16
Total	836	202	1,038	386	91	609
TRAILER-PROPS						
Boeing	38	—	38	39	—	39
Vanguard V-800	43	—	43	20	33	43
Boeing 720	180	8	178	13	12	174
Rockwell Y-802	136	16	147	105	17	147
208	289	—	289	239	17	309
Friendship F-37	120	22	142	93	17	130
Boeing 737	—	—	—	—	—	—
# F. Harbin	10	9	19	—	—	17
Cessna/Cessna 340	16	—	16	14	—	16
Total	831	54	887	727	89	838
CARIBO TRAILER-PILOTS						
Canadian C-460	12	2	14	—	9	9
Army/HB100	2	3	5	1	18	10
Total	14	5	21	1	19	19

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Information, aircraft built to USAF STAN. States are not included in this table. It is known, however, that a small number of B-52s and B-57s have been delivered to units of Commandant, USAF.

ing downtown to set up a site," he said, "that also, thus repeating the out-of-city cycle.

"The pattern we see wouldn't fit a number of them," he said. "And while the competition might want us to make segments, we don't think that could match us on the overall schematic pattern." The company presented its findings to the Office of Safety and Security, which is responsible for managing the WTP, WTP, A2V, FWP, FSD, C1 104 and/or credits was selected to assign the required numbers for the year 2014.

The TWA will try to convince people to go to new places for their vacations. "How long would that van can fly to Libya instead of Miami, the same length of time, and at less cost?" Bell said.

**Pan Am to Run Tests Of Inertial Navigation**

Washington—The American Airlines will conduct a year-long evaluation of an inertial navigation system in a DC-9 in a series of 90 flights, 54 of which will be conducted enroute under a \$22,510 contract awarded by the Federal Aviation Agency (AW June 14, p. 93).

Elmetec says a Doppel navigation system will be supplied to Litton Systems Inc., a subsidiary of Litton Industries under a \$200,000 FAAS contract which includes studies of the use of the military-type global positioning system for air traffic control and routes for air traffic. Litton is scheduled to deliver the equipment to Pan Am in about six months.

# AIRLINE OBSERVER

► **Lester**: firms on the North Atlantic appear to be in the talking at the International Air Transport Assn. public conference at Chandler, Ariz. (AW Oct. 3, p. 20). However, the drive for lower fares, being led by Lufthansa German Airlines (AW Sept. 24, p. 41), could become bogged down in the question of conditions under which new rates will be applied. Caution opposed to lower fares is expected to propose conditions such as time limits or seasonal rates to prevent present level of revenue yield.

► **Watch**: for British cabinet to approve full participation in the British Pacific express air transport project by Pan American, Panair and British Caledonian. British have already allocated funds, but British have limited participation in a comparatively small contract with British Aircraft Corp. for continuing design study. Initial British funding probably will involve allocations of about \$150 million.

► **FAA**: last week gave general aviation pilots and 14 U. S. airlines permission to use the new Dallas International Airport near Watauga, Tenn., D. C., for familiarization and training purposes. The terminal's control tower and associated navigation aids were commissioned Oct. 1, but the airport is not scheduled for dedication until Nov. 17. Airlines who gain experience en route than transports to the Dallas mobile lounge, without charge, until the inauguration of scheduled service.

► **Order**: by Alitalia for five Douglas DC-8 transports powered by Rolls-Royce Conway by-pass engines in January. Possibly that the order will include some DC-8 convertible passenger/cargo planes in store.

► **American Airlines**: negotiations are starting to eliminate from their contract the provision for mandatory retirement at age 52. An Lone Starites and Strandedness Assn., a division of the Transport Workers Union, contends that the age limitation is discriminatory, since it is not employed by any other U. S. carrier. ALSEA members so retired are forced to take low-paying jobs and are often being replaced by foreign workers recruited from foreign countries, the union claims.

► **British Overseas Airways Corp.**, which is concluding its pool agreement with British Airways (AW Aug. 26, p. 41), will supplement its British Britannia long-haul flights with a twice-weekly service between Accra and London with Boeing 707 by-pass engine-powered transports. Britannia will be operated on the route on a three-weekly basis. Ghana Airways' B-180 transports apparently will be used only on flights from Accra to Kumasi every two weeks.

► **Federal Aviation Agency**: last week began using Air Defense Command's huge new FTS-55 radar at Montauk Point, Long Island, to monitor airway traffic between Boston and New York City. The Mostostar installation, part of the Seacat intercept system, will tell Interjet type FAF's radar coverage of the northeastern coastal area. The agency plans to begin using another FTS-55 radar at Boston, Pa., later this year to implement coverage of the area between New York and Cleveland.

► **Belgian airline**: VASF has ordered four Sud Caravelle Model 6 transports and has taken an option on two additional aircraft. VASF is the fourth Brussels airline—Sofin-Virg, Prado de Bondt and Cimmo do Sul—to buy the twin-jet transport. Sud's Caravelle backlog now stands at 159 firm orders from 21 customers in 19 countries.

► **International Assn. of Machinists** and PAA are keeping a close eye on possible administrative violations among four labor districts. Nearly a year ago IAM began providing PAA with a continuous report of alleged violations committed by the carriers. Volume of these reports has increased sharply whenever labor disputes have arisen, but the current one is not considered serious, the union said.

► **State Department**: will not schedule any more bilateral negotiations until a U. S. international air transport policy has been adopted by the White House (AW Oct. 3, p. 23).

## SHORTLINES

► **Federal Aviation Agency**: has awarded a \$134,937 contract to Mason Electronics Corp. for the development of an experimental TACAN transmitter.

► **Federal Communications Commission**: has estimated the size of frequency 122.6 mc. in Apr. 1 in permit required participation of carriers in FAA's direct point-to-point intercarrier tests.

► **British Airlines** of Spain has ordered six additional Douglas DC-8 turboprop transports at an estimated cost of \$51 million.

► **Lufthansa German Airlines** has been flying donated medical supplies and food at its own expense to Tibetan from Germany as an aid to refugee victims. Lufthansa has conducted a similar operation from the U. S. to flood-stricken areas in Spain.

► **Maintenance personnel** will be employed next month by FAA as a means of evaluating aircraft configuration and maintenance programs. FAA and program have remained unchanged for 30 years and probably should be reviewed to meet maintenance requirements in handling more complex aircraft.

► **National Airlines** now plans to retire its fleet of piston aircraft by 1971, after which it will operate all flights with Douglas DC-8 turboprops and Lockheed Electra turboprop transports.

► **Northeast Airlines**: request that authority given in measured section of the New York-Florida marginal cost be withheld from the public has been denied by the Civil Aeronautics Board. Northeast held that publicity about any pending merger would be harmful. The Board stated that the testimony reveals no definite plan for a merger between Northeast and another carrier.

► **Sabena Belgian Airlines**: has reported an 18.5% increase in traffic during the first six months of 1962, compared with the same period last year. Load factor for the period was 60.5% compared with 57.2% in 1961. Number of passengers per passenger carried in the first half of 1962 increased 18%.

► **U. S. tankers**: have agreed to extend the no-refuge period and overcall constraints for flights between Jan. 10 (AW Oct. 3, p. 30). Overcall restrictions provide that indicated pressure in the hold compartments will be canceled if they fall 50 pounds below levels less than 30 minutes prior to flight departure.



## A fuel cell for Apollo

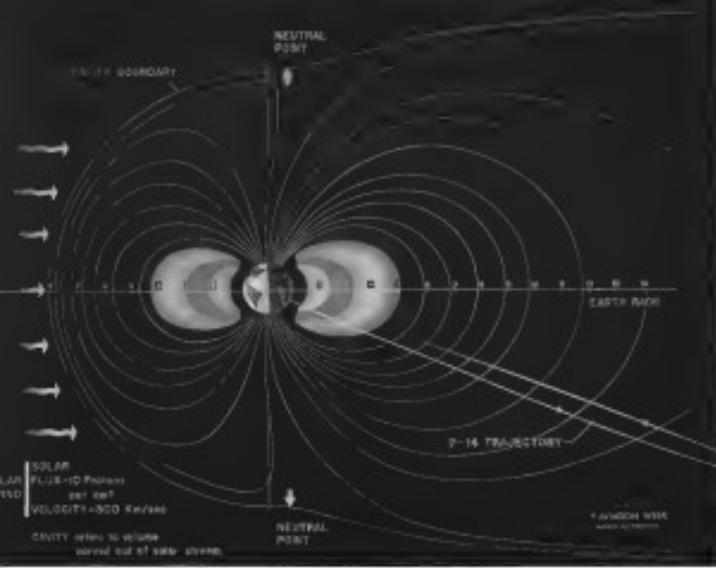
This is a model of a fuel cell designed by Pratt & Whitney Aircraft—the company chosen to develop a fuel cell system for Apollo, America's first manned lunar craft. The Apollo spacecraft will be built for NASA by North American Aviation.

The hydrogen-oxygen cell will supply power for environmental conditioning, communication, instrumentation, and scientific equipment. In addition to generating electricity, the fuel cell will provide water for Apollo's three-man crew.

**Pratt & Whitney Aircraft**  
U  
A  
Pratt & Whitney Aircraft Company  
Stamford, Connecticut

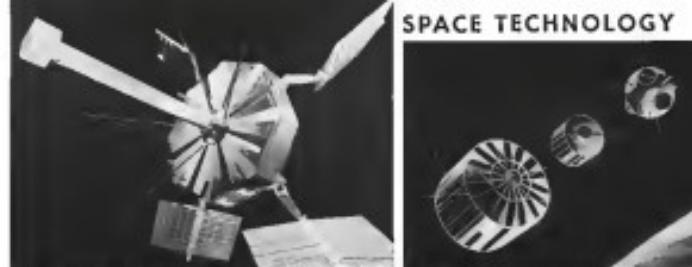
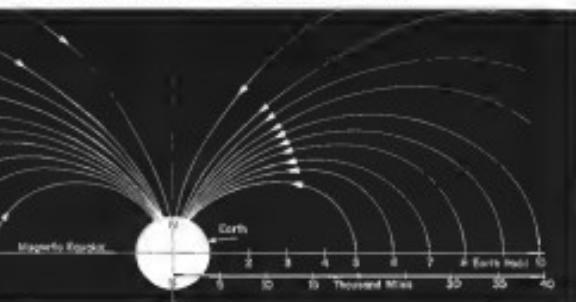
Pratt & Whitney Aircraft's fuel cell is far more efficient than conventional power systems. During tests, cells have demonstrated efficiencies of 70 to 80 per cent.

The fuel cell has a significant role in space. Moreover, it promises to be a significant power source on earth. Pratt & Whitney Aircraft is currently studying fuel cell power systems for such applications as remote-site power, vehicle propulsion, commercial power generation, and other industrial tasks.



**NEW PICTURE** of the geomagnetic field, shown, which has been developed as the result of data from Explorer 10 and Explorer 12 satellites, shows the effect of solar wind passing against the earth's field as it curves around and out of the field shown by the north. On the dark side, the earth's magnetic field gradually merges with the borderless interplanetary magnetosphere. Explorer 12 measured

the extent of the field on the night side, and Explorer 10 passed through the early boundary at the lower edge of the drawing at a distance of 50,000 m from the earth. Below is a cross-sectional drawing of the geomagnetic field as it was believed to appear in 1945 before the opportunity became available for direct measurement with satellites and probes.



**EXPLORER 12**, launched Aug. 11, 1962, found the outer limit of the trapped radiation regions at altitude of 40,000 m. Its satellite is center at right, first detected and measured new radiation zone centered by another blast.

### Space Sciences Expansion—Part I:

## Research Challenge Encompasses Galaxy

By Edward H. Kolton

Washington—Growing interest and increasing knowledge in addition to new detection equipment will soon see the way of the space sciences, whose primary laboratories are now the vast reaches of the farthest reaches of the galaxy.

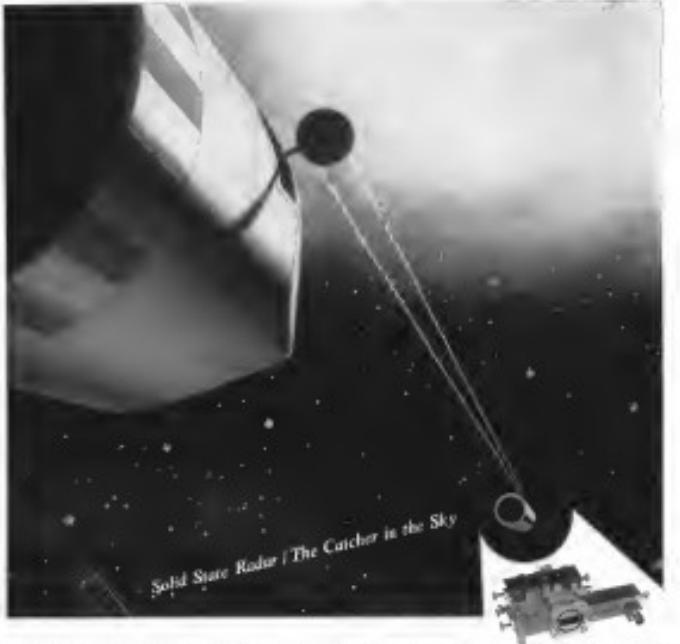
The space scientist today is charmed by a new impatience to exploit the rapidly filling storehouse of data collected by instruments already launched toward the perimeter, but differing atmosphere outside of the earth. Information from space will not only help man in his search for understanding of the universe, but will furnish the critical data points required to design, engineer and equip manned and uncrewed space vehicles.

Although the technique of sending instruments into space to make direct measurements at a relatively new stage, a steady line of progress can easily be traced in the development of the space probe, the basic vehicle of space technology. It has forced a closer association between the scientist and the engineer so that now the U. S. can perform such feats as designing, building and launching a special satellite in just 60 days to sample the radiation in the lower edge of the Van Allen belt, measured in a U. S. nuclear detonation for July 9 (AVO Sept. 17, p. 36).

Each space science payload, drawn and the geomagnetically-trapped radiation around the earth, they have mapped the belt measured in counts/second and found at least five distinct intensity zones within it. They have sampled the atmosphere, provided 350,000 photographs of the cloud cover over the earth, and have established the basis for advancements in the art of weather prediction and analysis that will save

### Major Space Science Experiments

Project	Launch	Significance
<b>I. ELECTRIC PARTICLE</b>		
Explorer 1	Jan. 31, 1958	Discovered Van Allen belt electrons
Explorer 2	Feb. 17, 1958	First fast ion belt wave mode study
Explorer 4	May 28, 1958	Proved that ion belt wave mode consists of Langmuir (high-energy) protons
Explorer 6	Aug. 7, 1959	Detected electron wave burst arising from ion cyclotron resonance
Explorer 7	Oct. 13, 1959	Studied ion cyclotron resonance waves with Pioneer 3 probe from beyond orbital radius
Explorer 10	Aug. 18, 1961	Liquid hydrogen test cut by finding that outer wave emission is upshift of low-energy protons
Explorer 11	June 28, 1961	Measured and measured high intensity radiation belt (spurred by July 9, 1961, U.S. nuclear test detonation)
Pioneer 1	Oct. 11, 1960	First the Van Allen belt (ion cyclotron resonance) was measured
Pioneer 2	Dec. 4, 1960	Discovered what was thought to be a second radiation zone
Pioneer 4	Mar. 5, 1961	Confirmed Pioneer 1 and Explorer 7 data
Pioneer 5	Mar. 13, 1961	First to measure the radiation belt near the magnetic equator after being magnetized by increased solar field and polarizing plasma in deep space
<b>II. MAGNETIC FIELDS</b>		
Pioneer 1	Oct. 15, 1960	First detailed rotation between earth's magnetic field and atmospheric particle measurements
Explorer 10	Mar. 25, 1961	Discovered strong effect of the earth's magnetic field on the shock wave caused magnetopause
Explorer 12	Aug. 18, 1962	Detected magnetic field on the earth's lower edge, averaging on altitude of 40,000 m, measure of magnetic field intensity; found daily variation there in space
Rocket Flights		
<b>III. COSMIC RADIATION</b>		
Nova 850 Satellites	Oct. 1961	Detected that solar flares differ in rays than those bright ones on the sun, capable only 2% of the solar energy
<b>IV. ELECTRICAL RADIATION</b>		
OAO 1	Mar. 7, 1962	Confirmed radial field solar reflection is limited when bright rays open the sun, capable only 2% of the solar energy
Rocket Flights		
Blastoid solar spectra as observed from OAO 1, 2,700 megacycles observed near X rays in the E region of the atmosphere		



## Solid State Radar / The Catcher in the Sky



A new solid state radar system built by STL engineers and scientists can send out and receive signals at X-band frequencies to help map rendezvous and dock vehicles in space. STELATRAC is its name; it is the first solid state system of its kind. The X-band transmitter is shown above. It has independently panned temperature and vibration tests. STELATRAC can also be used as a command link between vehicles in flight. By altering its module design, the flexible radar system operates as an altimeter and Doppler velocity sensor to guide spacecraft safely to the surface of the moon and planets. Today STL is busy on many such projects in STELATRAC. STL is also prime contractor with NASA's OGO and a new series of classified spacecraft for Air Force/ARPA. And STL contains Systems Management for the

Air Force's Atlas, Titan and Minuteman programs. Their activities create immediate openings in Theoretical Physics • Systems Engineering • Radar Systems • Experimental Physics • Applied Mathematics • Space Communications • Antennas and Microwaves • Inertial Guidance • Analog Computers • Solid State Physics • Computer Design • Telecommunications • Space Physics • Digital Computers • Guidance & Navigation • Electromechanical Devices • Engineering Mathematics • Aerodynamics • Propulsion Systems. For Southern California or Cape Canaveral positions, write Dr. R. C. Porter, Department A71, One Space Park, Redondo Beach, California, or Box 4277, Patrick AFB, Florida. Your inquiry will receive a prompt reply. STL is an equal opportunity employer.

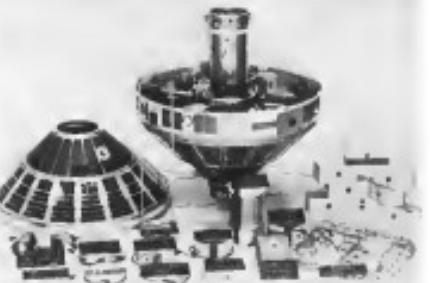


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PIONEER 5 (above) was in a polar orbit, monitored a solar flare, measured drag coefficient under Van Allen belt zone and detected particles and impurities in deep space. Solar flux measurements were made simultaneously with those of Explorer 7, shown with experiments discontinued below.



around billions in damage caused by storms.

This here provides new, precise information about the ionosphere to increase the quality and reliability of radio communications. They have discovered a layer of helium around the earth and spectrum and energetic particles in deep space. They are applying data which are not in predicting solar storms and other manifestations of solar activity for warning space explorers.

This late spring the theory that sunspot counts and electric field intensity are equal signs and have strengthened the thesis of the essential role of sunspots, which say that each major sun spot is the center of its own

system containing new plasma.

In doing these things, space science has set the stage for a new chapter of research, more-and-less continuous, of the physics of the plasma in atmosphere, of ionosphere which will continue as fast as 50 different experiments in the plasma, electrical and biological disciplines.

The goal is a detailed map of a hostile, fluctuating environment.

The immediate, practical requirement of the informed lunar landing program is to understand well in the scientific goals usually categorized as "space astrophysics," are being translated into hardware, experiments and programs by National Aeronautics and Space Administration's Goddard Space Flight Center

located at Greenbelt, Md., near Washington.

Goddard's management techniques and its current and planned programs were reviewed in AVIATION WEEK (See 2 pp. 178-183, 1955). That makes the space U.S. impossible to measure each satellite, some of which are developed privately and the others by industry under Goddard's supervision.

At Goddard, the space science program consists of twin related experiments designed to gain understanding of the solar-terrestrial relationships—the way the sun's emission influence space in the sun's vicinity, and more particularly, the way these emissions influence the earth's magnetic field and atmosphere.

Dr. Harry J. Gortt, Goddard director, sees the program in an 11 year perspective to the solar cycle, in which the number of solar storm peaks and ebbs on a fairly regular schedule. A composite picture of the earth-sun relationship, Dr. Gortt said, will come from data obtained from space vehicles flown throughout the period.

Presently, the U.S. is considered to have entered the quiet age with the launching of the Explorer 1 satellite on Jan. 31, 1958. Scientifically, the decade begins its space program on April 16, 1946, when the first of 64 captured German V-2 rockets was launched from White Sands, N.M.

From 1946 until NASA was established on Oct. 1, 1958, the U.S. had fired an estimated 400 rockets in an upper-atmosphere research program. Not all were successful, and support for the rocket program was often sporadic and always meager in comparison with the U.S. space program today.

Studying solar winds, in the embryo stage, through probes in the upper atmosphere, the White Sands and Cape Canaveral teams found there was that they gave scientists a means to learn how to do things in space—like to measure and how to measure. They shot down thinking in the physical sciences which had to evolve into slow for experiments for satellite and probe payloads.

Major studies in space have been in these areas:

- Solar physics—The source of the sun's energy.
- Interplanetary particles and the relation ship of these particles to electromagnetic fields.
- Ionosphere and its interaction. This is the subject of ion-velocity partition to measure the earth's ion clouds which indicate and influence the quality of radio wave propagation.
- Atmosphere, the field that describes the pressure, density, temperature and concentrations of the atmosphere.
- Aerodynamics—observation of the thin,



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	CMS0121250	0.07	10,000	0.08	
8 Pole	CMS0121750	0.18	7,000	0.44	
	CMS0121750	0.18	7,000	0.44	
	CMS0121750	0.18	7,000	0.44	
TACHIMETERS	Volt. 1,000 turns	Signal Values	Linearity		
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amounts of protons and electrons by analysis of the light they emit.

Discovery of ground-self-excited pulsations surrounding the earth, and subsequent interpretation of this discovery by James Van Allen of the State University of Iowa, marks as the major scientific discovery of 1958. Discovery is itself is ingenious, but its application in this case is that it demonstrated the entire field of physical science enough by demonstrating the value of the earth's satellite as a measuring platform.

### Experimental Evidence

There has been speculation before this discovery that the earth's magnetic field was strong enough to trap energetic particles. Because of a lack of experimental evidence, it was not known how many particles were trapped, extent of the trapping, and makeup of the particles.

Beginning astrophysics measurements, which are continuing, show that the earth's field is similar to a dipole magnet, and the magnetic gradient extends into a broader non-dipolar magnetic field called the magnetosphere. The magnetosphere contains paths of ions with energetic particles, and is disturbed by currents in the earth's magnetic field, leading to compression on the sunlit side and expansion on the other. As a result, the region in which it exerts major control over energetic particle paths varies from 34,000 to 52,000 km from earth—which defines the outer limit of the Van Allen belt as the limit of the solar wind.

### Stress Measurements

Chronology of direct measurements in the Van Allen belt shows these highlights according to Goddard's Leo R. Davis and George H. Ludwig:

- Explorer 1 discovered a region of high energetic energy with a single Geiger-Muller counter. Finding was verified by Explorer 3, launched Mar. 26, 1958, with similar instrumentation by the Army, which also had launched Explorer 1. The particle counters on these instruments were able to detect high-energy radiation, but were unable to determine the nature of the particles—whether that was electrons or protons.

Spaniard 2, launched Nov. 3, 1957, penetrated the inner zone of the trapped radiation at apogee, which was set at the long axis of USSR tracking stations. The satellite also had no tape recorder. With a recorder as a more extensive tracking network, Soviet Russia could have substantiated its claim, made after Van Allen's, that Spaniard 2 discovered the Van Allen belt.

- Explorer 4, launched July 31, 1958, was designed to survey the magnetosphere to altitudes of 1,400 km, and

particular to determine the number and makeup of particles. This was an Advanced Research Projects Agency (ARPA) project and was flown in cooperation with ARPA's Argon high-altitude nuclear explosive.

Basic findings were that the upper zone of trapped radiation contains large, of penetrating protons with energies greater than 30 million electron volts (mev). Explorer 4 went through the lower region of the outer zone and found no penetrating protons. This Argon experiment indicated that electrons released by nuclear explosions are also trapped in the magnetosphere.

- Pioneers 3, 5 and 6 provided the first information on the extent of the outer zone. Pioneer 1, launched Oct. 11, 1958, by the Air Force under ARPA, sponsored an attempt to place a satellite in a lower orbit, reaching an altitude of only 70-75 km, but discovered that the outer limit of the magnetosphere lies either in geosynchronous orbit or change location. This phenomenon was subsequently attributed to the proton current in the low-energy proton and electron component emitted by the sun, called the solar wind. Another important finding of this probe was that the outer zone radius is close to the earth.

### Pioneer 3 Data

Pioneer 3, launched Dec. 6, 1958, by the Army and also intended as a house probe, reached an altitude of 55,500 km, and its success supplied data during both forward and return flights. It is difficult to determine what this was due to, though it is possible that the satellite was brought to a standstill by the solar wind. Subsequent experiments indicate a number of zones, but no distinct limit between the zones.

Comparison of data from Pioneers 3 and 5, the latter launched by the Army for ARPA on Mar. 3, 1959, reveals the theory that the outer limit of the magnetosphere varies directly with solar activity, and goes back to the particle source that is the sun in the principal source of particles in the outer zone.

A helter that crossed until the last leg of Explorer 12 was that the outer zone was made up largely of electrons. • Explorer 6, launched by NASA on Aug. 5, 1959, with a weight of 1,000 lb, determined the ring current ring, starting from 20,000 to 25,000 km, determining the ring current ring. The same zone of trapped radiation between the altitudes of 20,000 and 25,000 km. This satellite mapped the Van Allen belt between 9.2 deg. north and south latitudes using a proportional particle counter array, an ionization chamber, single component magnetometer and scintillation.

- Explorer 7, launched Oct. 15, 1959, monitored the lower region of the belt

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Day to day performance of 0.1% is verified throughout over a 12-month period and later obtained. The King gyro has been subjected to temperatures of -40° F without damage. In 1960, mean life averaged 1.8 million hours from the temperature. In addition, time utilization was found to vary a total of 0.25% from 0.95% being over the temperature range of 70° to 100°.

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Mounting Requirements (deg. spread)	±10.0
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Response (Sec)	0.075

### FEATURES

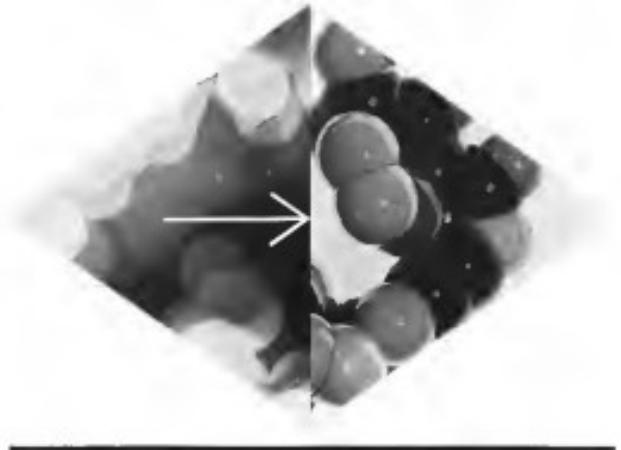
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between the altitudes of 144 and 673 km. Lower limit of the trapped radio was about 600 m above the earth's surface. Complete study of the phenomena of solar events occurred during the spring of 1960, when data from Explorer 7 could be compared with data from the Venera probe, Parus-1, and Pioneer 5.

Pioneer 5, launched May 13, 1960, on a trajectory toward the planet of Venus and into a solar orbit. A large fairing covered the HGA and Pioneer 5 registered a decrease in cosine ion intensity, called Faraday decrease, 22 hr after the fairing was jettisoned.

The Faraday decrease had been thought, as the basis of ground-based measurements, to occur only in the presence of the earth's magnetic field. But Pioneer 5 registered the decrease even when the probe was well outside the influence of the earth's magnetic field.

### Solar Plasma

Computations based on the Mar. 30 data led to the finding that the solar plasma affected the probe at a radius of about 200 m ( $1 \mu\text{m}$ ). A second major flux occurred April 1, and the transit time for particle fluxes that states was measured at 450 m/sec. This has led to the exciting finding that solar protons spread around the magnetic field lines of the solar plasma cloud, and that the protons in the second cloud followed the channel made by the particles of the first cloud.

Pioneer 5, with a long list of accomplishments, also measured the magnetic field between the earth and sun, verified the existence of new currents discussed by Explorer 6, and detected penetrating radiation in deep space.

The magnetic field between the earth and sun was found to be between 3.7 and 4.8 gauss, the latter measure made during a solar storm. Magnetic field at the surface of the earth varies with latitude between 35,000 and 72,000 gauss.

Explorer 12, launched Aug. 13, 1961, spent earlier theory by showing outer zone growth largely of low energy protons, and not electrons.

### Outer Zone

Composition of the outer zone became a subject of scientific controversy shortly after it was discovered by Pioneer 3. Following the assessment of Explorer 7 data, the theory, however, was that the zone was dominated by low-energy electrons, probably in the 10-100 eV range, with a density of  $10^6$  to  $10^7$  electrons/ $\text{cm}^3$ .

After the brief flurry of findings summarized in mid-1960, a Soviet geomagnetic scientist and theorist, K. I. Gerasimov of the Radio Engineering Institute of the USSR Academy of Sci-

ences, postulated that the number of particles in the outer zone was three or four decades (power of 10) below the U.S. figure. He based his theory on extension of data from Lunik 2 and 3, but because the theory was not validated by direct measurements, it was not accepted here at Russia.

Data from Explorer 12 are still being analyzed, but the scientists have detected the low-energy proton extension, as claimed by Gerasimov, in the outermost part of the magnetotail. The total electron flux in altitude of 4,000 m above the surface of the earth to the edge of the field, which averages 40,000 m altitude. Data of the particles has been found to have an upper limit of  $10^6$  particles/ $\text{cm}^2$  sec.

The NASA energetic particle pro-

gram has been the most active in the agency, and has been supplemented with data from Discoverer and from Transit, Intelsat, and other satellites in the Geod and Department, launched by the Defense Department.

### Two Theories

The result of satellite and ground-based measurements at this time is that scientists have returned to the two theories regarding the origin of the Van Allen belts.

The first, at minimum data, theory, is widely accepted as the explanation of the inner zone. This theory postulates that heavy galactic and solar protons, particles interact with the atmosphere at an altitude of about 20 km. Neutrons are stopped from the particles and spin



Inset: Aerojet 400-ton acoustic chamber. Right: 400-ton pressurizer.

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off in all directions, decaying into protons and electrons, which are trapped in the magnetosphere.

The second theory holds that solar and galactic particles are directly injected into the magnetosphere and are trapped there until they gain enough momentum to escape.

Theories on the cause of auroras also are unproved, and the origin of the energetic particles that cause them remains a mystery.

The two most widely accepted ideas are that the particles are injected directly from the sun, so that they are deflected from the Van Allen belts, which act as a stochastic

### Magnetosphere

Explorer 10 satellite, launched May 25, 1965, has provided the most significant measurements of the earth's magnetic field and its interaction with the solar wind. Vanguard 3, the first satellite to measure a magnetization produced data as a detailed mapping of the near-earth field after its Sept. 14, 1958, launch.

Dr. Norman F. Ness of Goddard explained that because of the dipping of the geomagnetic field, by the solar wind on the side of the earth away from the sun has been the most important force field disruptor of satellites. In addition to this finding, Explorer 10 results indicate it is this solar wind that creates the magnetic field which shapes the magnetosphere on the earth's dark side.

The satellite crossed the earth's boundary on the dark side at an altitude of 30,000 m., allowing a fine plot of the magnetopause front and westward flow picture, p. 50.

Since Explorer 10 determined the dipole curve, Explorer 12 made the measurement of the boundary on the world side as it varies from 70,000 to 12,000 m., averaging an altitude of 40,000 m.

None of the three satellites which have made major contributions to information on the magnetic force field—Vanguard 3 and Explorers 10 and 12—has shown the existence of the steady ring current in the outer zone of the Van Allen belts. The phenomena was detected in Explorer 8 and was confirmed in Explorer 9.

Power 1, launched Oct. 11, 1958, returned data which substantiated and extended previous data from sounding rockets. Rocket probes had indicated that magnetic field intensity decreased as a function of distance from the earth as an inverse cube relationship. Power 1 found this to be true to an altitude of 27,000 m., but found no similar relationship beyond that point.

This probe also determined that there is a relatively distorted transition between the earth's magnetosphere and

auroras from their edges are generated in space. Particulate materials are generally selected and prepared with a Binks Formulator, and spray/poured with a high speed Binks Turbulent Gun.



## Spray/pour fairing blocks

### Foamed in place with Binks Formulator and Turbulent Gun

One of the country's largest aircraft manufacturers recently eliminated a costly and time-consuming manual operation. Uncut foam from fiber strips, which serve as foaming blocks in the trailing edge of the wing leading edge extensions, formerly were pre-formed and placed...then glued into the channels individually by hand.

Now, with a Binks Formulator gun and a Binks Turbulent gun, uncut foam is spray-poured directly in place.

Key to the success of this new technique is G-1000 Formulator gun, which mixes the catalyst and resin materials...G-1000 thorough mixing of the materials and speedy application

before reaction takes place in the gun.

The Binks Formulator provides extremely accurate metering. Rates with viscosity ranges as high as 62,000 cps can be maintained.

A high-speed mixing device is incorporated in the head of the Turbulent gun. When resin and catalyst are mixed, they are almost instantaneously discharged.

This is only one of many ways Binks spray/pour equipment is serving the aircraft industry. For further information, call or write Binks Company, 1000 North Paulina Street, Chicago, Illinois, 60610, or for more spraying techniques, write in the address below.

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# When you follow these welding instructions— you can perform wonders with "T-1" Steels

USS "T-1" Steel, and "T-1" type A, are two of the most weldable steels ever developed. Their combination high yield strength (100,000 psi minimum), outstanding toughness, and ready weldability, designers have taken advantage of this remarkable combination of properties to build stronger, lighter structures of many types, and to improve the performance of an impressive array of heavy duty equipment.

Achieving great strength and toughness in a steel is not an earthshaking event. But combining these properties with weldability is, as in the case of USS "T-1" and "T-1" type A Steels. It is this weldability that permits the designer to take full advantage of the strength of "T-1" Steels.

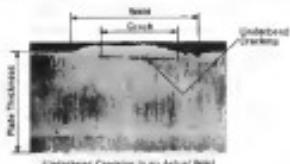
Steels have treated constructional alloy steels, USS "T-1" and "T-1" type A Steels, are among the strongest high strength steels. They are not difficult to weld, yet offer more strength, reliable joints are obtained when the following three procedures are followed. We invite you to read them as a guide to realizing the full potential of USS "T-1" Steels. They are detailed in a booklet which includes a Welding Heatinput Calculator, and in our new welder-training film, "How to Weld USS 'T-1' Steels" (see coupon).

## RULE 1—Use the proper electrodes

When manual-arc welding "T-1" Steels, use only electrodes with low hydrogen coatings. Or, use a welding method which is "low hydrogen," such as submerged-arc or submersed-arc welding.

Hydrogen is the number one enemy of sound welds in "T-1" Steels, as in all other steels, because it causes undercutting cracking, resulting in unreliable joints.

To be sure you get the best results with correct electrodes, never use low-hydrogen coatings as designated by the last two numbers of the electrode catalog, as 15, 16 or 18. None other. For example, E6015, E6016, and E11018 are satisfactory for welding USS "T-1" Steels.



When you want to be positive that the heated weld is as strong as the parent "T-1" Steel, use E11016, -16, or -18 rods.

Never use electrodes or wire flux combinations containing vanadium to weld "T-1" Steels. If the weldment is to be stress relieved, Weld metal containing vanadium is likely to be made brittle by stress relief. Stress relief is only necessary with "T-1" Steels when re-

quired by codes and one or two other special cases.) Turn coating with high yield strength ("T-1" Steels to a lower-strength steel, use low-hydrogen rods of the strength level recommended for the lower-strength steel.)

Proper handling of electrodes is also important. When exposed to air, low-hydrogen coatings will pick up moisture which is a rich source of hydrogen. Keep your electrodes dry. Make it a practice never to open more than 30 minutes' supply of rods at a time. A sure way to keep rods dry is to keep them in a 200°-300° oven. If your rods have absorbed moisture, bathe them in an oven according to the manufacturer's recommendations. This is true in 500° oven.

To sum up Rule 1, for manual welding use low-hydrogen electrodes and keep them dry. For submerged-arc or inert-gas shielding arc welding, use thoroughly dry fluxes and water-free shielding gases.

## RULE 2—Use correct welding heat

On most kinds of structural steels, high heat input results in superior welds. With "T-1" Steels, just the opposite is true. The best welds in "T-1" Steels depend on never getting over a certain maximum amount of heat. Less heat is used so the weld will cool quickly. In "T-1" Steels, results in good, tough welds. Thus, you must closely control the amount of heat put into the weld.

In this section, never preheat "T-1" Steels, except in special cases. Preheating requires more heat to get rid of and a longer cooling off period, which can be harmful to welds on "T-1" Steels. The cases in which preheating is necessary are those in which the steel must be warmed to get rid of excessive moisture (a hydrogen source), where the pressure is so restricted it doesn't have room to shrink after welding, or when thick pieces over 1" are being welded. Much of the time, however, preheating isn't necessary, and never preheat "T-1" Steels on French shores.

The heat you put into a weld depends principally on arc voltage and electrode speed. The higher the voltage, the faster the electrode speed, the greater the heat input. The slower the speed, the higher the heat input. Controlling heat input requires keeping an average below certain settings and keeping the speed of arc travel above certain speeds.

There are two other important items to keep track of: sheet thickness and temperature. Thicker anchorages can safely soak up more heat than thinner ones, so you can use more amperage and slower speed. As for temperature, the anchor may have been heated up by pre-heating or by previous passes of the electrode. So if the section is already hot, you must cut down on amperage or increase speed to avoid excessive heat input.

## Heat Input Calculator

There's an easy way to determine the safe heat input for USS "T-1" Steels. The circular Heat Input Calculator which is provided with the book offered in the coupon, will let you quickly find out what amount of heat will result from any given setup, and determine how much more you can safely put in. It is a



circular "slide rule" which tells, on the front side, the heat input that will be put into the weld by varying the amperage, voltage and arc speed. On the back side of the calculator are tables showing the safe heat inputs for "T-1" Steels at several different thicknesses at different temperatures. This handy device is designed to help you get good welds every time. Heat inputs may also be calculated from this formula:

### Heat input per inch

Amperes x Arc Volt x 0.0314 = Heat Input (Inches)  
Spool, inches per min. = Perinch of weld

## RULE 3—Use recommended welding procedure

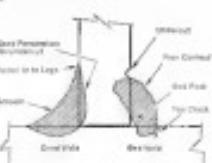
The straightforward stringer bead method is preferred for welding "T-1" Steels. Do not use the "half weave" method. Weaving degrades the metal more because the arc travel speed is slower and may cause excessive heat input. The proper method is to lay the groove with a succession of stringer beads.

Before a bead can be laid over an earlier bead, the first, aside, or condition must be removed.

**Rock gauging.** The preferred method is air-air gouging followed by clean-up grinding. Do not use an oxyacetylene torch, danger of overheating which may cause an unsatisfactory joint.

**Speed.** Whether you control speed by machine or hand, control it closely. The Heat Input Calculator described above is your guide to the proper speed to avoid excessive heat input.

**Fit-up.** Good fillet welding technique is more important with "T-1" Steels because the joints are usually required to withstand greater forces. Fillet welds in "T-1" Steels should be smooth, correctly contoured and well tailored to the legs of the pieces to be joined. The layers of each weld should be made so that there is a good root penetration but no undercutting. The weld shown on the left is ideal; the one on the right is to be avoided.



When thick pieces are present, and when the weldment is to be stress relieved, fillet welds can be troublesome because of toe cracking. There are several

ways to eliminate toe cracking near fillet welds on "T-1" Steels. In the case of Tee or fillet joints where lower strength welds are often the rule, use low-hydrogen rods of the E60, E60, and E70 classes. Being lower in strength and more ductile, they are less likely to "pull cracks" at the toe of the fillet weld.

An alternative peening of the weld can also be very helpful in preventing toe cracking, especially when higher strength rods (E30, E30, and E40) should be used to save costs. If peened, sometimes it is necessary to peen each pass, in other terms, peening only the top passes will prevent cracking. After peening, the fillets should be smoothly ground to fair the fillets into the legs of the joint.

Other methods that can prevent cracking include use of a soft-wire pedestal, machine grooving the base of the upright pieces, and laying down "butter" welds in the toes. The first two methods allow the upright leg to "shrink down." The "butter" weld strengthens the "T-1" Steel in the area where a toe crack might start. If it is ground off prior to actual fillet welding and must be located so that the toe passes of the fillet will be laid right over the strengthened zone.

## Free Welding Help.

The above information is spelled out in greater detail in our free book "How to Weld USS 'T-1' and 'T-1' type A Steels." Included in the book is a Heat Input Calculator that helps the welder choose the proper welding machine settings, thicknesses, currents, and electrode sizes for your shop personnel. Order from the address below. Use the coupon for the name of a distributor in your area. For welding USS "T-1" Steels, Bend the coupon. USS "T-1" and "T-1" are registered trademarks.

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### Gentlemen:

- Please send me \_\_\_\_\_ copies of "How to Weld USS 'T-1' Steels."  
 Also send me your catalog, sales memo and/or the State memo.  
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the magnitude of interplanetary space, starting at an altitude of about 5,000 km.

#### Chorus Rays

Goldberg has noted previous, as yet, unexplainable studies carried on rocket payloads to obtain data on the charge composition of solar cosmic rays, according to Dr. Carl E. Feldman of Goddard. Ray loss streaks in electron plots which in effect are signatures of few charge and energy spectra. Most heavy primary cosmic rays are stopped in broken apertures when they strike the atmosphere, and rockets provide a means of monitoring above that influence.

From ionosphere confusion payloads sometimes have discovered that at least four recognizable different east between cosmic rays from the sun and those from outside the solar system.

The differences are found in the ratio iron-to-sulfur-to-oxygen, light to medium, helium to neonium, and medium to lower charge groups.

Space agencies have been perplexed by the belief that sun stars other than the sun contribute importantly to the particle flow of cosmic rays which strike the earth's atmosphere, and has long sought the origin of the particles that come from stars other than the sun.

Ross notes, however, that the sun has unusually high energies compared with the energies of other stars, and space research has found that the particle contribution of both galaxies and solar cosmic rays is negligible.

#### Solar Physics

Even though stars outside the galaxy add to the cosmic ray population, the sun is the star which exerts the greatest influence on the earth and on man's activities in regions deep space. By track from space vehicles will examine the diffusion and obscuration of the earth's atmosphere which prevents direct measurements of the ultraviolet, X-ray and long radio wave spectra from earth.

Although the sun's nearest neighbor is observed directly by satellites and man-made, these vehicles will lessen the effects of the opaque gases streaming from the lower atmosphere. Now it is therefore not so absurd to compare the diffusion and obscuration of the earth's atmosphere which prevents direct measurements of the ultraviolet, X-ray and long radio wave spectra from earth.

Dr. John G. Landis, chief of solar physics at Goddard, feels the sun is a body which is continually making out alterations about itself. "All we have to do is to find out what is going on," he said, "to build the telemetry code."

First attempt to break the code with instruments which continually point at the sun came last May 7 when CGO I

was launched to cross communication above the obscuring influence of the atmosphere. These instruments are measuring the ultraviolet, X-ray and gamma-ray spectral regions.

Analysis of data from this satellite shows distance which solar flares emit particles, and possible role in predicting solar flares.

The Apollo mission humans landing mission schedule depends on a long test on whether the U. S. can develop a gamma technique for flare prediction. Apollo energetic cells for human landing in 1970, about two years after the solar minimum. Delays in this schedule will increase the hazard because the number of solar events increases in a peak in 1969-70.

Four successive attacks on the merits of the sun came during the International Geophysical Year in 1958 when a number of rocket payloads observed the sun in ultraviolet and X-ray wavelengths. The progress has continued since, with the general procedure being to launch rockets during solar storms. For example, NASA launched seven rockets Nov. 13-16, 1960, during the largest solar event ever observed.

Ultraviolet spectrographs obtained from rocket payloads, and indoctrinated into the CGO I, indicate that most of the solar radiation comes from a very small portion of the surface of the sun. The "bright" sun contributes only about 3% of the total solar surface, and are covered with sunspots.

With its ability to point continuously at the sun, CGO I is analyzing the spectrum in detail in an attempt to reduce fully basal spectral bands to precise

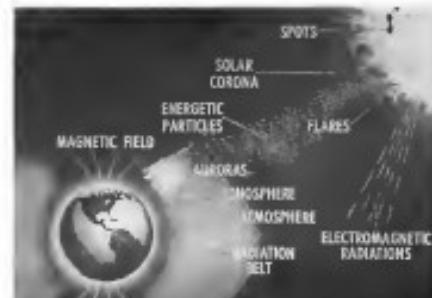
means. Other spectral bands are identified, ground-based spectrographs can determine the composition and abundance ratios of the solar elements.

Investigations on board CGO I are measuring in the 1 to 10, 10 to 400 and 1,000 to 1,500 angstrom bands. New studies in the next 5-7 years will include a high-resolution ultraviolet spectrometer which will measure from 100 to 3,000 angstroms.

These fundamental findings of space science experiments in the area of energetic particles, magnetic fields and solar photons (ultraviolet, visible, p. 50) have served as the foundation of much of the present objectives for the ultraviolet-gamma-ray space observatory. According to Landis, these objectives be done:

- Galileo: cosmic ray measurements of the charge spectrum, relative abundances of isotopes, energy spectra of ion currents, protons and energy spectra of albedo electrons, electron intensities, photon and other particles, cosmic rays causative and their directional characteristics.
- Solar flares: particles, relationship between elements in the solar storm and in the sun itself, particle fluxes as a function of time, energy spectra of electrons, and correlations between the production of energetic solar particles and phenomena such as visible flares, coronal streams, solar tube noise, coronal holes, the particles, geomagnetic disturbances, and solar hole structure (sunspots and coronae).

• Solar plasma: Fluxes and energies of energetic electrons, evolution of plasma as a function of time and position, and a



SPACE SCIENCE STUDIES are focused primarily on the solar terrestrial relationship, plus sources of which are shown in this National Aeronautics and Space Administration drawing.

evolution of the plasma, as well other solar and geophysical behavior.

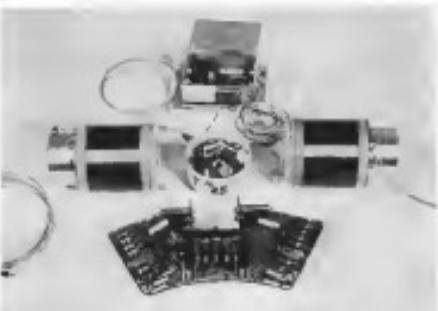
• Van Allen belt: energy spectra of the outer zone as a function of position, and characteristics of the nose as a function of time. Detailed study of the energy spectra of electrons, protons, and ions in directions as the nose, and complete total histories of solar flares and the relationship of these flares to particle magnetically-trapped radiation.

Most important objective of research in the earth's magnetic field according to Dr. Neil is a complete survey of the geomagnetic fields in the dark side

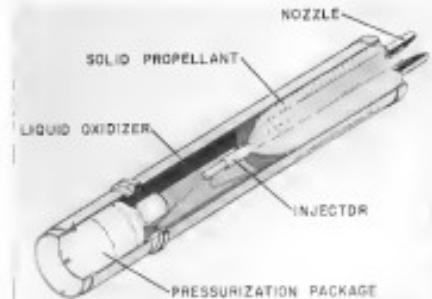
This study will determine the complex behavior, interaction and effects of solar plasma and the earth's magnetic field.

Dr. Glatt estimates that the observatory experiments described will meet the majority of objectives will may be made possible at scientific experiments in the earth's earth surface during the next 10 years. These will be supplemented by smaller satellites designed for special-purpose measurements.

(Part 1 of this story will discuss an overview of the atmosphere and service power.)



**HYBRID YAROS MAGNETOMETER** equivalent to the Explorer 18 satellite demonstrated damping effect of the earth's magnetic field on the deck ride. Redline: hemi and gas cells are in the center, coilcells at st. leg, and amplifiers, bottom.



#### Navy Tests Hybrid Rocket Motor

Drawing shows new hybrid rocket motor, combining liquid and solid propellant, which has successfully fire-tested today at Navy Ordnance Test Center, Md.

# ENVIRONMENTAL TESTING TAKES EQUIPMENT



Aerotest Laboratories now offers added environmental test facilities for reliability, qualification and pre-production testing, system, subsystem and components. The layout of these (32 x 14 x 24'), shown above, is capable of handling full sizes or missile sections, so that complete systems or complex environmental systems can be tested under controlled conditions of temperature, altitude, humidity, etc.

Another walk-in chamber also handles sizeable aerospace packages... measuring 6x7x10' and operating at temperatures of -120°F., humidity of 95%, and altitude to 150,000 ft.

In addition to these facilities, Aerotest has many smaller environmental and thermal vacuum chambers available for economically testing all sizes and types of aerospace components and systems... plus complete test equipment for simulating both natural and induced environments, shock, vibration, low-temperature, LCR, and ultraviolet cleaning, oxygen gas dynamics and propellant loss for static and cryogenic tests and condensers.



# Floodlights Considered as Light Source for Night Lunar Landings

By C. M. Peltier

Bethpage, N.Y.—Night lunar landing research programs under way at Grumman Aircraft Engineering Corp. here indicate a need for additional light sources, possibly floodlights, about the planned lunar landing vehicles.

Investigation is part of a company-funded study of lunar landing, started last January and now in the preliminary evaluation stage. Grumman has been an active bidder on different phases of Project Apollo, including the lunar excursion module, and it is pursuing an independent lunar research program at its own expense to remain competitive.

Rosenthal has been placed on night landings other than dry landings at Grumman's Research, National Aerospace and Defense Space Administration facility in Long Beach, Calif., and of the lunar night-to-day landing problems brought up by the 1966 laser day. Laser day, however, occurs when a portion of the sun's visible surface is no longer obscured by the sun, i.e., the dark portion of any ring less than a full moon. During this time, primary illumination of the lunar surface comes from light reflected from the earth (earthshine).

Studies by Grumman of available data, including Russian studies, of composition of the lunar surface and outside light available from earthshine has indicated that lighting conditions during night landings on the moon are roughly the same as on Earth, with an average reflectivity coefficient of 0.7 and 3.4 foot candles of incident light yielding only .05 lumens of bright light.

Single integrated display is also part of the evaluation program. This is believed necessary because pilots have experience in controlling landing gear while in the main frame, controlling pitch and rate of descent.

Schroeder's 6 deg of random surface floor motion which appears to the pilot on a translucent screen in front of the cockpit. A beamless light source projects a cross on the screen to repeat what the landing gear. The cross gives leggy or smaller and free to move in all directions, thereby indicating altitude, lateral and longitudinal translation and landing to the pilot. Ball appears as a translation of the cross on the screen. The simulator is kinematically simulated and must about the pitch and roll axis to provide the additional 2 deg of motion.

Forward landing technique is to start from about 12,000 ft and descend at an approximate 10deg angle straight ahead, with a maximum of lift at right translation to about 10 ft above the surface. An ideal approach would look something like a steep 0.8 landing approach. With all related factors skipped, the final descent of 10 ft at

atmosphere probably provides a different shadow environment than exists on the moon, but that's all. Although it is not known what type of shadow an object and by means of light on the surface, calculations of pilot depth perception could be effectively refined if they are different than those experienced on earth.

Landing light systems, possibly a bank of floodlights about the base landing vehicle, has been suggested by Grumman to ease the night landing problem. Such a system would illuminate the landing path similar to those employed by conventional aircraft, and, according to Grumman engineers, would be preferable to flares.

With additional light and a forward landing technique to help alleviate dust problems, Grumman believes night landings can be made double. Evaluation of a forward landing technique is being carried on in a flying-off-the-ground lunar landing simulation.

## Simulator Construction

Simulator has the capability and cockpit configuration of a single-engine aircraft. Primary control instruments are on the front panel and include angle and rate of pitch, yaw and roll, lateral, longitudinal and roll trim rings from point of intended landing altitude, rate of descent, thrust and translational velocity.

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**3 MICROWAVE SYSTEMS** Dalmo Victor has been deeply committed to microwave systems for many years. Leadership has been established in telemetry, automatic tracking, telecommunications, and distance measuring with capabilities for possible participation in future R&D on lunar landings.

**4 MAGNETIC SYSTEMS** Another Dalmo Victor achievement area, involving such unique developments as anti-submarine and antisubmarine warfare systems, system analysis, sensor development and vehicle control systems, real time data reduction in magnetism, and in related fields.

**5 AERONAUTICAL EQUIPMENT** In conjunction with California Technical Institute, another Texas concern, Dalmo Victor developed a wide range of precision navigation and ground environmental equipment. From a highly effective communication system to environmental test facilities, Dalmo Victor offers unique single-source accountability.

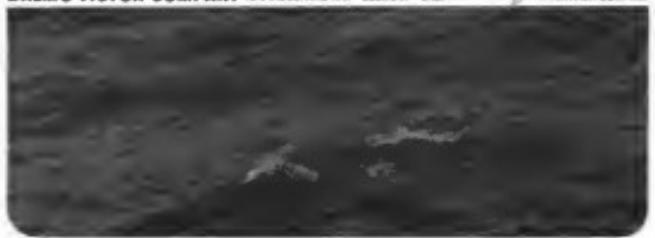
The group responsible for the bulk of the many Dalmo Victor achievements, Science, R&D and engineering of unusual ability are needed in further R&D and other Dalmo Victor assignments. If you would like to work in this creative atmosphere, and enjoy the many advantages of living in the San Francisco Peninsula area, investigate a career with Dalmo Victor. It can be most rewarding.



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## Mobility for any mission-LOH/Hughes

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ler would be created by dropping nuclear bombs and dropping in the nuclear bombs gravity is enough to do that at that of the earth.

Pilots have performed the approach in 60 sec within the fuel requirement felt necessary. NASA requirement is that the faster landing vehicle be able to hover for 2 min.

Garrison engineers feel that their design will be behind the vehicle in a forward nose-down type of landing approach to a large extent, giving better stability as well as providing pilots with the opportunity to look over the front at lower altitudes. It is also felt that since the proposed landing without concern for a vertical landing, pilots will not try to make mistakes.

Routine jet control integrated with the modular utilizes a finger tip control stick which presently has a response rate of 10 deg/sec; as all three axes Pilot studies, as far, have indicated a need for greater response, and plans have been made to increase the rate to 15-20 deg/sec about all three axes of the system.

Garrison feels the three-axis finger tip control is easier to use and more efficient than the present analog stick controller and will provide greater efficiency in the Apollo vehicle or the three-axis control for two reasons:

- Greater dynamic range. Because control can be moved faster through a given deflection, providing more sensitivity. Garrison also claims the finger tip control requires less energy input than with the stick control.

- Gains can be obtained during periods of acceleration or deceleration by mounting the control perpendicular to a frame. The control is approximately 31 in long with a 1 in diameter bar on the end and may be gripped easily by the pilot while in either a seated or horizontal configuration.

Landing studies at Garrison are being made for suggesting that the last 1,000 ft. of landing will have to be made under visual point control. Ensuring a hostile environment for the first nose and landing under lighting conditions similar to the pilot will necessitate techniques, particularly at the final vehicle approaches the landing site.

At present, the three attitude studies being conducted at Garrison have two purposes—to optimize a con-trol system and also to explore better landing techniques.

The company has been asked by NASA to evaluate internally, without funding, the three-axis finger tip control and the two-axis stick control with radar pitch which is presently called for in Gemini and Apollo. The company plans to start on this evaluation within a month.

## NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

**HEADING SYSTEMS, WASHINGTON, D.C.** \$100,000. An Army-McDonnell Douglas team will conduct preliminary studies of production and operational use of four instruments used to control

**NATIONAL RESEARCH COUNCIL, MONTGOMERY, ALA.** \$100,000. The National Research Council has contracted for an investigation of the effects of

**GENERAL ELECTRIC COMPANY, BINGHAMTON, N.Y.** \$100,000. General Electric will conduct

**GENERAL ELECTRIC COMPANY, Washington, D.C.** \$100,000. General Electric will conduct development of fibrous and impregnated materials for use in aircraft

**UNIVERSITY OF CHICAGO, CHICAGO, ILL.** \$100,000 for training of graduate students in space-related science and technology.

**UNIVERSITY OF CALIFORNIA, LOS ANGELES, CALIF.-\$100,000. The University of California will conduct research and technology**

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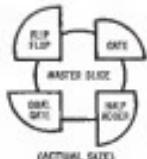
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# MASTER SLICE



(ACTUAL SIZE)

**SOLID CIRCUIT** semiconductor networks are manufactured from pure silicon "master slice" wafers (center illustration) which contain more than 30 separate circuit bars. Customized interconnection patterns (four corner wafer diagrams) are then photo-stripped in aluminum or "master slice" wafers, producing completely integrated semiconductor networks ready for packaging.

SEMICONDUCTOR/COMPONENTS  
DIVISION



Graphical **SOLID CIRCUIT** semiconductor network integrated ICs shown.

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Texas Instruments now offers you hundreds of variations in **SOLID CIRCUIT** semiconductor networks. Today you can get the exceptional reliability and miniaturization benefits of **SOLID CIRCUIT** semiconductor networks in many customized designs — at only slightly more cost than standard, catalog circuits. The flexible "master slice" design concept developed by Texas Instruments makes this achievement possible.

**HERE'S HOW:** First, standard "master slice" integrated circuit bars — complete except for interconnections — are taken from established, high-volume production lines. Second, a special interconnection pattern mask for your circuit is prepared. Third, your special interconnection pattern is photo-stripped in aluminum off the "master slice" circuit bar.

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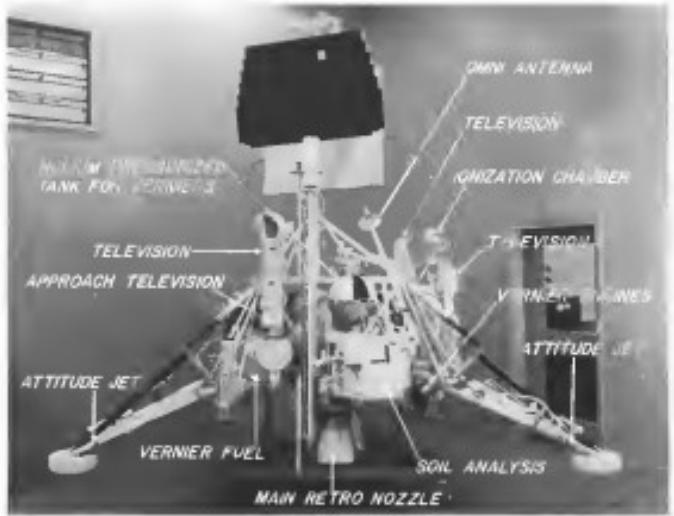
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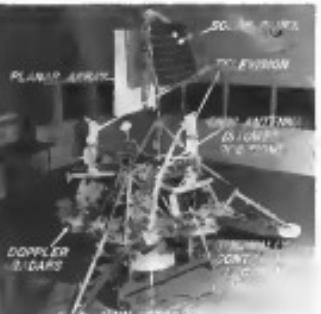


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**ENGINEERING MOCKUP** of Surveyor soft-landing lower equipment being fabricated by Hughes Aircraft Co. for Caltech Jet Propulsion Laboratory enables engineers to check gross interfaces and television events via video. In first flights, probably starting in summer of 1964, Surveyor will not carry full complement of instruments shown on flight-weight spinoff (above) in effort to cut payload

gross weight to meet anticipated decrease in lift capability of early versions of its Atlas-Centaur booster. Surveyor appears to plan to bypass stripped-down instruments with the exception of its television television camera that will scan moon's surface during post-landing phase of mission. Downward-looking television camera is integral part of flight control.



AVIATION WEEK AND SPACE TECHNOLOGY, October 8, 1962

## Surveyor Vital to Manned Lunar Program

By Barry Miller

CALIFORNIA CITY, Calif.—Complete operation prototype of a Surveyor spacecraft designed to land on the moon's surface and return to the earth data collected by a series of onboard experiments will be successfully launched next summer or early in December. Surveyor, one of National Aeronautics and Space Administration's key lunar projects thus will move into its test phase.

Addition of instruments on the improved Surveyor units to demonstrate controlled, or soft, landing on the lunar surface is regarded as a crucial step in the sequence of scheduled events leading to access of a similar soft landing of men on the moon.

In addition, scientific instruments and television cameras aboard the seven Surveyor landing spacecraft hopefully will obtain information about laser characteristics—lunar reduction curves over solar bearing and that they are the long wavelength. The information will be available for use in future lunar sample design and other aspects of lunar exploration and will be a boon to academic knowledge.

### Surveyor Development

The more Surveyor spacecraft and other integral elements of the system are being developed and fabricated here by Hughes Aircraft Co., which was selected to incorporate systems now under way along with two years ago (AW Jan 30, 1961, p. 50, Feb. 20, 1961, p. 70). The company has been working under a contract of approximately \$70 million from California Institute of Technology Jet Propulsion Laboratory, which has responsibility for the project within the framework of NASA's overall lunar program.

Surveyor consists of two spacecraft—Surveyor A, the soft-landing vehicle, and Surveyor B, a vehicle used for orbital capture around the moon to secure extensive stereoscopic pictures of potential Apollo landing sites and to acquire other scientific data. The two types are called the lander and the orbiter, respectively.

Gehrer will be a heavily modified version of the lander spacecraft, plus a special 90-lb. dust census instruments test package, called Visual Instrumentation Subsystem (VIS), which means to the spacefarer as a paintbox. A core team for this source evaluation will be put together by early next month.

Hughes isn't funded for the orbiter spacecraft, although it does have trade names for the first and probably will get the fabrication task. About \$112 mil-

lion is included in NASA's current budget for all costs associated with five orbiters. This includes spacecraft development, launch vehicle, orbits and institutional support.

Once the orbital prototype of the lander, designated T-31, is completed later this year, it will undergo a corrective phase that may last as long as three months. It will then be moved to JPL's Goldstone tracking site at the Mojave Desert. There, a command and data console will command the spacecraft through a Deep Space Instrumentation Facility (DSIF) site, just as it obviously will be expected to do when the spacecraft is orbiting through space or sitting on the lunar surface about 210,000 mi. away.

Later, T-31 will be transferred to Holloman AFB, N. M., where it will be separated from a large nose, no center socket engines fired and "booster tests conducted to spot unanticipated coupling with the vehicle's electronics."

Roughly planned for the final lunar spacecraft weight of about 2,100 lb., with about 33% allocated to scientific instruments. Roughly 40% of vehicle weight is constant. In the spacecraft propulsion system for making moderate excursions in orbit to the moon and for slowing the descent to the lunar surface.

The 2,100-lb. figure is a 400-lb. reduction from earlier weight limits re-

commended by the McVord that at least the early Centaur booster versions, which the spacecraft will ride, did not have the originally anticipated payload capability. Weight savings are gained at the expense of a slightly reduced instrumentation payload and consequent diminution in the spacecraft's reentry's solid propellant.

Pure flight of a lander probably will not occur before the summer of 1964, almost a year's stretchout in schedule resulting from Centaur development delays (AW May 28, p. 13). Hughes is continuing to work on its orbital lander and is using the additional time for more extensive testing and possible spacecraft improvements.

### Moonup Unchanged

General external makeup of the lander in the same as that described by JPL previously (AW Feb. 22, 1961, p. 70), although the spacecraft's appearance, subject to change with a combination of continually revised requirements, will differ from the original model.

It has a tripod shape with characteristic landing legs spaced 180 deg. apart about the structure, an off-center, extendable booms supporting a solar panel and a broadside, high-gain directional plasma sensor array, and a large spherical solid-propellant retrofitter, to slow

## Lunar Environment for Surveyor

Design of the Surveyor lander is heavily influenced and constrained by the strong, tightly unknown tides environment. The spacecraft and its payload must be able to sit stably without any possibility of 20 deg. (or a flat or sloping) surfaces that can be hard or soft, packed with rocks or other paraphernalia.

On the basis of what it knows now or thought to be reasonable extrapolation about the moon, Jet Propulsion Laboratory has advised Hughes on the lunar environmental model it should assume for engineering design studies and subsequent development of the Surveyor A (lander) lander.

Hughes has designed the vehicle to survive these more stringent environments than the environment that the lander model presented. Some of the unknowns may be removed yet as the Surveyor lander is developed, but it is difficult to do so in the next 15 months. Yet even these gotten may not lead into the present only enough to satisfactorily locate the effort allotted by Hughes and Jet Propulsion Laboratory in designing the spacecraft to meet the broad range of possible environments.

Assisted by environmental conditions for Surveyor include:

- Lower strength of a vacuum.
- Slopes greater than 15 deg. will not be encountered, although it is necessary to land probably of spacecraft survival if slopes of greater than 15 deg. are encountered.
- Surveyor will be landed to within 10 cm. (about 4 in.) will not be encountered.
- Pressures greater than 10 cm. (about 4 in.) will not be encountered.
- Radiation of lunar surface will range from that of red wood to that of very bad red.
- A Surveyor descent module has been dropped under simulated lunar conditions and survived crossing this range, will also be tested on simulated lunar dust (crumb powder).
- Friction properties of lunar surface are uncertain.
- Surface dust conditions are uncertain.
- Lunar surface temperature varies from a maximum of about 215°F during direct sunlight to a night-time temperature of -240°F. Reflected power of the lunar surface is 10%.

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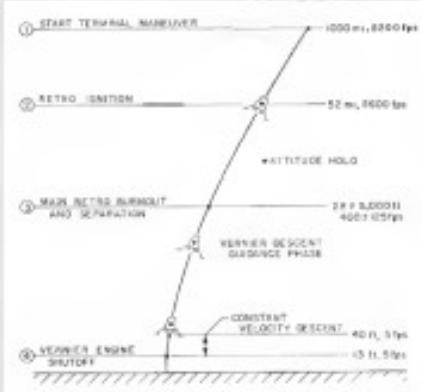
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**IN TERMINAL DESCENT PHASE OF FLIGHT:** losing only a couple of minutes the space craft's propulsion and flight control systems attempt to cushion the vehicle's descent to the home surface and land it aligned within 4 deg. of the home system.

down hill descent, connected to the

spacecraft orientation at landing.

Virtex has a 1.5 to 1 bond-to-bond capability. That is, after we individually thinnable over a thermal range from 30 to 104 °C. The entries employ a hyperglycylate passivation. It has two test sites per package, one for the conductive-epoxy interface and the other for the pads. The pads are machined to a

With a helical presentation mode, the various elements are all well folded together and portions of the system, particularly the mirror, are recognizable in accompanying photos of engineering renderings of the helical.

What has to be done now is make a sufficient supply for the west sector, reduce the massive, and the most possible damage. Should as one possibly large, redundant structure have to be made, it was suggested to cover the massive, least which, at the Range 3 mission earlier this year, the vendor stated could cause this, according to Dr Leo Shostak, Sovremen's project manager.

High-speed engines have found an unusual solution to one of the principal problems of operating on the lower surface-grounding electrons cause noise from the erosion of heat insulators, which is avoided if the specified operating range for many engines extends down to a decrease

Complete redundancy in the vehicle's telecommunications system—a redundant voice channel and a redundant data channel—means no loss of service.

current in NASA spacecraft like the Syncom and Relay satellites, is designed into Syncom.

Spacecraft will carry two high-power transmitters (30 to 12 w.), two low-power transmitters (100 milliwatts) and a pair of receivers, all designed for operation at S band.

Any of the four synthesizers can be connected to either of two receivers, and linked to either of the spacecraft's two omnidirectional antennas. During transit, one transmitter and one receiver specific to Hughes as a transponder to assist the DSCS system in tracking the spacecraft. The telecommunications gear can employ solid-state components throughout, with the exception of low-gain wave tubes in the transmitter.

Also aboard the spacecraft is a single central data processor which accepts data from small, individual processors linked with the instruments and can encode analog data and store some data on a tape recorder which may be jettisoned as the spacecraft. A central command decoder also is planned for the telecommunications package.

Mission numbers of spacecraft commands are supplied from groundstation ahead the vehicle, the *Gal*, by radio command. This is a medical deposit from Baugé, which operates primarily via onboard commands supplied by a program. The word is made pos-

opened after touchdown, are grouped into two compartments situated in either side of the squatpost. The squatpost is enclosed in a case made of copper insulation, about 100 sheets of shielded Metal which minimizes thermal conductivity and thus cuts down on conduction from the compartment.

During the latter eight, when electrical equipment and instrumentation operates at a minimum, about 3 w of power are generated internally to maintain the positive voltage in the tightly closed compartment between 16° and 50°, while outside the heat source can run up to -230°.

During half daylight, when operation of instruments reaches its peak, and exposure heat is greatest in the compartment, both thermal switches (10 to one compartment and in the other) force contact closure so that they are attached to the compartment to ages about 15 ms sufficient to prevent heat insulation from the compartment. The thermal switches are solid hermetical elements which expand directly when heated, providing a force to close a contact and open the insulation.

sequently, it cannot be launched during the day because the angle between the earth and sun is insufficient to present a maximum dihedral. Sun, or, on the other hand, requires light from the TV after-hour television and needs a minimum of five to seven seconds of sunlight for battery charge. Using Canopus and the sun as references, it can be launched near full moon and can be on the moon during most of the night.

Canopus' wind-down method refers to stations which provide command through a single program and transmit its own. The given signal is used to three attitude control nitrogen tanks that control the spacecraft to yaw, pitch and roll. The spacecraft continues the long trajectory in the coast mode.

the first time in the flight sequence. While in the TV picture will arrive at about 10 sec., it is recommended that slowly enable ground controllers to act on their site, so they will provide positive the landing site and prevent emergencies that you know the location of the landing site. If the soft landing is not successful, at least pictures of the landing sites will have been stored. During a normal descent, as the vehicle approaches under gravitational attraction the sensor, an 8.81 MHz radar site antenna located in the rear cone of the instrument, indicates when the aircraft reaches the predetermined no-go position altitude of 32 m. At this point, the spacecraft should be dropping 8.00 rpm. 400 rpm faster than of rotation of the terminal plane. Then the sensor site antenna, pointing out the rear of the aircraft, and the third control unit in both sites, are triggered.

determining these vehicle components and precise altitude and fuel flow. This data links to other elements of the flight control system to wall out ground proximity, and assist the spacecraft via hazard detection.

At a predicted point, the engines will switch to full thrust, briefly holding the spacecraft at constant velocity during descent from 40 to 13 ft and then crashing down. The spacecraft, descending at about 5 fpm, drops the last 13 ft to the surface. As it reaches ground, it is expected to be a nonexplosive 5 deg from the horizon normal.

#### **Lunchdown Speed**

### Solving Problems

survived problem, continuing de-  
livered 11 eggs, which hatched into  
11 live and otherwise healthy  
fledglings. The nest was 5 m.  
above ground, situated in a dense  
leafy spruce and asured good  
protection from predators.  
No nest, according to  
proper plans, leaves the center  
of the dragonfly's environment.

qual, and for strong altitude velocity information, do the flight controls when intersecting with gases. Surprise index will open broad.





## THE FIGHTER-BOMBER THAT CORNERS AT MACH 2

The remarkable F-104 is a true Mach 2 weapon system. Not only can it fly Mach 2 missions for hundreds of miles, even with missiles mounted on the wingtips — it can perform combat maneuvers without loss of speed. For example, it can execute a steady 3.3G turn at Mach 2.

The secret of this performance is the extra thrust inherent in the F-104 design. While many other supersonic airplanes decelerate drastically in combat maneuvers, the F-104's thrust margin makes its full speed available. The F-104 continues to hold the USAF record for time-to-intercept.

Six of our allies chose the F-104 over every other jet in the world. Dollar for dollar, frane for frane, mark for mark, no other fighter can match its performance or its versatility or its reliability.

The F-104 is being built by 21 major producers, 7 engine manufacturers, 31 major electronics companies and hundreds of other suppliers in 7 countries (including the United States). Four hundred F-104s will be built this year, 1,000 next year, more than 2,000 by 1964.

Never before have so many governments and so many aerospace companies been brought together to build one weapon for the common defense. **LOCKHEED-CALIFORNIA COMPANY**

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# X-20 May Supply Orbital Space Stations

By David H. Hoffman

**Las Vegas**—An F-104 Starfighter program now appears to be in its technical ground and USAF is studying how it might be used to supply orbital space stations.

This has suggested design Defense Department's interest in speed funds voted by Congress, the committee that set up X-20's military mission and two changes in budget, made last year.

No military mission has yet been assigned to the program. Nor has it been decided on the outcome of space rendezvous being made a part of the X-20 plan, raising concerns (AW Sept. 24, p. 21). But Air Force appears disengaged and in technical briefings to stress the program's potential show the declassified glider can deorbit with wheel-lashed stations in space, then deorbit as an elliptical trajectory back to earth.

As Air Force Under-Secretary Joseph Chaffey explains the subject, the X-20 has an "inherent" military role, but another in the peaceful. Robert Goddard's early rocket when this was developed. And one X-20 pilot told Aviation Week: "We're not just going to orbit around our friends." After the glider has proven operational.

Key to what USAF feels the X-20 should do in space is based in the capabilities of Triton 2's upper, or firm stage—capabilities that were added by Air Force to makeups with recent developments of the Gemini Command and Service module and the glider and adapter a soft landing to be secured by Stratoc.

## X-20 Chronology

- November, 1957—Development director for Defense, later to be called X-20, issued and development plan approved.

- March, 1958—Proposed second from man contractor.

- June, 1958—Two teams headed by Boeing and Martin selected to compete for prime Dynavon development contract.

- April, 1959—Air Force began evaluation of Boeing and Martin proposals.

- November, 1959—Boeing referred to manufacturer, assembly and test glider and adapter a soft landing to be secured by Stratoc.

- December, 1960—Air Force and Defense Department, then the Alpha study of Dynavon to study feasibility of the rendezvous, materials and construction approach adopted by Boeing. Study completed in April, 1960 resulted in no significant changes.

- December, 1960—Management history will Republic Co. named research and test center for Defense's primary government subcontractor. REX, named incentive research for communications package.

- January, 1961—Boeing awards first option of an aircraft to be used for the booster stage adapter. He ends the short notice, giving an option to retain a relative altitude of about 10,000 ft. He would hold the glider through a maneuver very similar to an attitude-maneuver turn. Hopefully, at this point, he would be in position to glide back to the so-called flat top at Cape Canaveral, thus salvaging X-20.

- January 15, 1961—Air Force announces decision to substitute Stratoc 2 for Triton 2 as Defense booster.

- September, 1961—Defense Department Air Force issues formal full-scale mockup of glider.

- December, 1961—Air Force receives decision to eliminate redundant flights and use Triton 2 as Defense booster (AW Dec. 23, p. 17).

goal to inject the Triton 2 payload—whether it be X-20 or a different payload—into either orbit or escape trajectory, or to carry the fuel after deorbit. When the fuel exhaust X-20 maneuver was interrupted, probably in 1963, that will be accomplished in steps. The first step is to get the glider on the ground, then the engine, then the payload. The second step is to get the payload off the ground, then the engine, then the payload. The third step is to get the payload off the ground, then the engine, then the payload.

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The first announced orbital flights of the X-20 are scheduled to begin in the Altitude Research Range late in 1968. Targets for next year are an altitude trial series to be held at Edwards AFB, Calif. During initial trials, 1968, the glider will be flown at various speeds so the pilots can evaluate stability and control, especially on landing.

An acceleration rocket system will boost the X-20 to supersonic speeds during a normal ascent of altitude. According to current Air Force planning, each of the six X-20 flights will be checked out in steep descents before a normal orbital flight is undertaken. First flight is another that is scheduled to take part in the test program is to be conducted at Boeing's Wright, Kan., facility in the spring of 1963.

The X-20's first orbital flight will be a suborbital test flight since a series that was delayed from the X-20's program was Air Force's planned development of the Triton 2's upper, or firm stage.

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Should the short engine recontact, the glider be damaged during liftoff or cause other pressing problem be encountered, the X-20 pilot might elect to use his ejection seat and descend by parachute. That the ejection seat which is not an escape capsule, undoubtedly

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**Soviet Missile-Firing Sub Sighted by Navy**

U. S. Navy photo of Russian missile-firing submarine shown in, or running lower, enabled to hold their vertical rudder for extended short range ballistic missiles, probably adapted long lead type missile. Navy said that type operates in both the Atlantic and Pacific Oceans. It is assumed to be in areas close to the polar region. Diesel-powered sub apparently went under fire about 25 G- and Zelenaya River area late last month to conduct tests from the surface (AW Mar. 8, p. 17). Russia also has several subs capable of launching missiles from underwater (AW July 30, p. 24; Apr. 2, p. 18).

would be disastrous if triggered after the glider reaches Mach 1.

Although the X-20 will have a much orbital capability—how much is not yet known—there are no plans to send a multi-payload crew aloft in the glider. The front of the glider can remain in orbit as a function of how much the remaining places are occupied with an aircrew, equipment, and supplies.

Then, I have to add, the glider will be held in orbit for about 20,000 ft until it reaches a low enough orbit of about 100 mi at 10,000 ft altitude to 1,000 mi. In contrast, the X-20's navigation and rendezvous weights are programmed to be about 11,000 and 10,000 lb respectively. The 5,000 lb margin between these figure furnishes an indication of what new approaches the glider into space likely in the process.

Precisely how the various maneuvers demanded of the X-20 will be executed still is an open question. Answers will come as the glider's handling qualities are finalized on the ground, or once the first flight begins. The first flight of the North American X-15, Air Force's first plane to bottoms at least a few of the six X-20 flights in the X-15, than is in evidence. Even with a minimum altitude and entry and the name of entry in a normal orbiter.

According to current thinking—though worse in the X-20 program Air Force agrees with this approach—the glider's who maneuver will begin with a 180 deg. heading change in space. After the turn, retrograde, are fired in the plane of the glider's planned turn. Re-entries will be in a single shallow glide that is to last roughly 30 min. During this relatively slow descent, the temperature is up to 4,000°F and the glider is damaged by radiation. The X-20 wing and fuselage skin is a parabolic

curve between the panels allow expansion when temperature rises above a certain point.

Prior to landing when the glider has been slowed to less than hyperbolic speed, heat shield must remain covering the forward sections of the orbicular. The front of the glider can remain in orbit as a function of how much the remaining places are occupied with an aircrew, equipment, and supplies.

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The X-20 program was given an initial go-ahead on April 25, 1960, when Air Force approved Boeing Plan. All of the major contractors, including contractor of the X-20, Aeroflex, Inc., in El Segundo, Calif., were awarded \$35 million, and in fiscal 1962 at \$100 million, with an additional \$35.8 million appropriated prior to August.

In fiscal 1963, according to USAF Under-Secretary Chaffey, Defense Department has not yet selected the \$15.7 million award to Boeing. But Air Force has asked and expects to get the money.

Production of early X-10-X-18 three-stage plantform hardware was to have begun last month by Aeroflex in El Segundo, Calif., facility. Because of this, the first flight of the X-20 is tentatively set for the end of 1963. The first flight of the X-15, Air Force's first plane to bottoms at least a few of the six X-20 flights in the X-15, than is in evidence. Even with a minimum altitude and entry and the name of entry in a normal orbiter.

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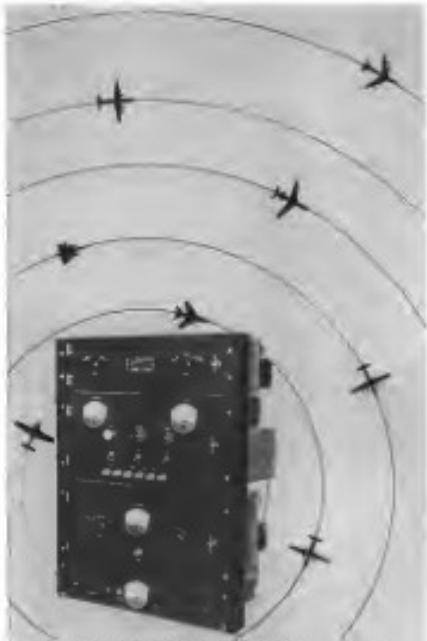
curve between the panels allow expansion when temperature rises above a certain point.

Signature of the industry toes the two engines, the primary powerplant carries the X-10 designation X-10. The secondary powerplant is a modified version of the same engine already being applied by Aeroflex to the modified X-10-X-18. Performance criteria

total thrust is approximately 7,000 lb. Specific impulse is about 115. The X-10-X-18's longitudinal, lateral, and roll moments of 10,000 lb-ft, 10,000 lb-ft, and 10,000 lb-ft, respectively, are to be supplied by the two engines. The X-10-X-18's longitudinal, lateral, and roll moments of 10,000 lb-ft, 10,000 lb-ft, and 10,000 lb-ft, respectively, are to be supplied by the two engines.

Purpose of the X-10-X-18 is to land the first flight re-





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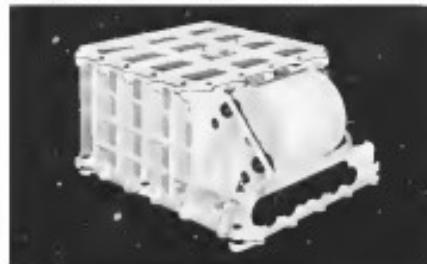
during rollout will bring the glider to a stop. Retractable nose gear skid is diamond shaped and has a diameter of approximately 10 in. Development is by Koralis Corp. under a \$75,000 sub-contract.

■ **Aerodynamic.** Eight controls. X-20 has dual rudders that double as speed brakes when pivoted away from the fixed position. It also has dual elevons, which, along with the rudders, are moved by hydraulic piston actuators. In turn, an aileron is move by electronic signals generated by the pilot's control stick. Electronic damping from the stick to the hydraulic cylinders are redundant, at an orbital component of the hydraulic system itself. Electronic flight control subsystem is by Minneapolis-Honeywell. Control stick is mounted at the pilot's right side, not between his legs, to enable manipulations despite rotation of the pilot's position. Sixty switches are in the cockpit of a hybrid aircraft. Electronic flight control system, being built by Bell Aerospace, is very similar to Bell's system for the X-15 and X-15.

■ **Structure and cooling.** Nose cap made of ultra-high temperature ceramic material is being made by Long-Tauze-Verghe to protect the forward section of the glider from severe temperatures. To eliminate thermal stress in certain sections of the X-20's frame, triangular polar arrangements prevent cross deformation—a technique commonly used in the construction of bridges, but not, according to Boeing, in aerospace. High metal alloy steel, machined at subatomic, plus heat resistant ceramics are the key components of the X-20's skin and frame. Heat management from the X-20's cockpit and equipment compartments will be handled in a cooling system soon found in The Garrett Corp.'s A3B research Manufacturing Division. System uses hydrogen from a storage tank into a heat exchanger where absorption takes place.

■ **Accuracy and electrical power.** Powering the X-20's generator in flight will be an accurate power unit designed by the Southwest Corp. Grievous hydro-generators will not consist of a transmission shunt, prime mover, gearbox, hydrostatic pump, propellant tank-tube and metering valves and controls. Direct waste of electric power will be a generator and control unit mounted on the glider's central power unit. Generator and associated components will be furnished by Wehrle-Electric Corp. A fast extraction subsystem, designed to collect and transmit X-20 flight data is being developed by Electro-Mechanics. Be warned, however, as the ground hand system required to power this relay circuit.

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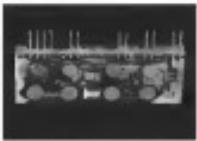
**Honeywell Building Block** (HBB) Computer (in open position to show internal logic). Now being marketed for production, the HBB guarantees high computer unit availability with low weight (18 lbs.), volume (50 cu. in.) and power requirements (40 watts). Designed for advanced avionics missions, it is representative of the many computers in production or under development at Honeywell.

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## COMPUTER NEWS



### WELDED MODULES UP RELIABILITY

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**BS. 100 Powerplant Installation  
Shown for Republic-Fokker D.24**



Model drawing (top, left), with supersonic external fueling and wing shape of the Republic-Fokker D.24 Allison Mark 2 plus VTOF fighter shows proposed installation except for the Bristol Siddeley BS.100 variable thrust powerplant, an advanced follow-on to the BS.13 which powers the present F.182? (SW Sept. 24, p. 88). For vertical shield (top, right), variable wings are extended fore-aft to prevent maximum surface area for pressure chamber housing. Bottom, left, BS.100 units are rotated to horizontal position in transonic cruise. Pressure chamber housing would be used as supersonic cruise with variable sweep reduced into fuselage (right).

#### PROBLEMATICAL RECREATIONS 139



Dr. Farbisher LeRouche, the noted mathematician, was shopping at a hardware store and asked the price of certain articles. The salesman replied, "One would cost 10 cents, eight would cost 10 cents, seventeen would cost 20 cents, one hundred and four would cost 30 cents, seven hundred and fifty six would also cost 30 cents, and one thousand and seventy two would cost 40 cents!" What was Dr. LeRouche buying?" —Continued

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**STRUCTURAL DYNAMICS**, to determine responses of an elastic space vehicle to transients such as launch, vibration, thermal, and engine ignition, vehicle storage. Openings also exist in establishing vibration environment based upon test or life prediction, and for evaluating structural systems and systems. Required for conducting tests of complete or scaled dynamic models of space vehicles including layout of test plant, instrumentation requirements, scaling factors, etc.

## THERMODYNAMICS ENGINEERING

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## MECHANICAL DESIGN

B.S., MEAS, or EIEE with experience in the design of missile or aircraft structures, and pneumatic or hydraulic systems.

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Technical Writers with senior college and/or formal technical training and experience in technical publications are required for writing of technical reports, technical manuals, material safety data sheets, organizational charts, technical manual change control, technical manual verification or proposal writing.

## PRODUCTION BRIEFING

Telco Industries, Inc., Mesa, Ariz., will develop a rocket impact crew escape system for the F-104 jet fighter, providing new options at ground level. The work will be accomplished under a \$1.5 million contract from Lockheed Aircraft Corp.

Coffee Radio Co., Dallas, Tex., has received a \$100,000 contract from the Boeing Co.'s Transonic Division to supply analytical responses to 65 Boeing 727 jet lines ordered by Eastern and American Airlines.

Brockton Instruments, Inc., Brockton, Calif., will build flow sealing equipment system to be used for the final payload flight control and other engineering design investigation on the X-20 (Dyna-Soar) program. Work is financed by a \$3.8 million contract from the Boeing Co.

Chrysler Corp.'s Missile Division is studying problems involved in the launching of large solid rockets for long range ballistic missiles. Solid ballistics dynamics, launching techniques and assignments of the shipboard complex. Novo 1 Bureau of Ships is sponsoring the study with a \$75,129 contract.

Ling-Temco-Vought, Inc., is developing a spacecraft heat shield, made up of a composite material designed to withstand heat insults under a \$1 million contract from National Aeronautics and Space Administration's Manned Spacecraft Center. Design will include an outer ablative layer and a means of real time access handles and windows. In provide thermal protection.

Gordon Control Corp., Durst, Calif., has been awarded a \$200,000 contract from Martin Co. to produce rate gyro packages which will detect excessive rate of attitude changes in the Gemini launch vehicle. The pack



F-104G Forgings

Two forgings manufactured by Koen, the main and chassis Corp., Inc., Pa., are used to house gyro's in tanks stored F-104G fighters produced in Europe for NATO.

# DEFENSE CONTRACT AWARDS

## Third Fiscal Quarter Summary—1962

Now available free from AVIATION WEEK & SPACE TECHNOLOGY are summary reports of defense contract dollar awards covering the third fiscal quarter of 1962. These reports show defense dollars awarded in 168 product/system categories as compiled by Frost & Sullivan, Inc. Information is also available on the fourth fiscal quarter of 1961; first fiscal quarter of 1962; and second fiscal quarter of 1962.

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Model # 4001-9 Intermediate  
Part # 4002-9 Intermediate  
Model # 4003-9 Intermediate  
Part # 4004-9 Intermediate  
Model # 4005-9 Intermediate  
Other 4000 series units are currently supplied by  
General Electronics Co. Major 4000 series component

Model	Robot Code
ECCO 4000	Series 4000
ECCO 4001	Series 4001
ECCO 4002	Series 4002
ECCO 4003	Series 4003
ECCO 4004	Series 4004
ECCO 4005	Series 4005

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United Technology Corp. will conduct feasibility studies aimed at developing a prognostic system for solid propellants, funded by the Defense Advanced Research Projects Agency.

It will be used in the validation of reentry vehicles (MDRV) of the classified Project X-20 (see AW, Sept. 3, p. 35).

Baldwin Machine and Mfg. Co., New Orleans, La., has been awarded a \$14,499,700 Navy contract to fabricate and convert the carrier ship SS Normandie. Work is to start January and completion is required in October 1980.

Union Carbide Corp.'s National Carbon Co. division has received a contract from Air Force Research Laboratories to produce three graphite cylinders, measuring 103 in. outside diameter, 34 in. inside diameter and 70 in. long, as part of a program to study the high temperature behavior of graphite in the large shapes which will be required in future solid fuel boosters.

G. T. Schieldahl Co., Springfield, Mass., will build two 135-ft-dia x 20-ft-tall passive communications satellites worth a \$290,000 contract from National Security Space Agency Administrator's Contract Spec. Flight Center Ballistic will be launched from a lightweight, plane-to-satellite launcher designed to allow satellite installation to pass through and not affect the ballast's orbit.

Hewlett-Packard, Inc., Ft. Worth, Tex., has received a \$770,000 Air Force contract for production of an infrared instrument which monitors jet engine condition by checking the average temperature and temperature spread inside the engine and records damage due to excessive heating.

Maxon Electronics Corp., New York, has been awarded a \$23,000 Federal Aviation Agency contract to develop new feedback techniques in an experimental TACAN ground station that enable it to determine if performance can be improved.

United Technology Corp. will conduct feasibility studies aimed at developing a prognostic system for solid propellants, funded by the Defense Advanced Research Projects Agency.

Brown Mfg. Co., Milwaukee, Calif., has received a \$2 million contract from McDonnell Aircraft Corp. for the production of certain avionics for Air Forces' F/A-18, intermediate version of the F/A-18 Hornets jet.

Lockheed Propulsion Co., Arcadia, Calif., will build a solid rocket motor for an advanced surface-to-surface missile development by Hughes Aircraft Co. Work is expected to be a \$300,000 contract from Hughes.

## NEW AEROSPACE PRODUCTS

### Instrument Illuminator

Lightweight head assembly, adaptable to standard instrument case, provides efficient illumination without modification of the instrument, the manufacturer says.



Four mounting screws hold the assembly to the panel, dispensing the need for separate mounting cleats. Wedge-shaped lens is made of clear acrylic plastic and lighted by an 8-V MS-24467-001 lamp held in a black enclosed aluminum housing plate.

Instrument viewing is around over an angle range of 150 deg., the manufacturer reports.

Oppenheiser Photonics, Inc., Wyandotte Rd., Willow Grove, Pa.

### Miniaturess Accelerometers

Two piezoelectric accelerometers—Type 4-273 and Type 4-275—are designed to measure high frequency acceleration found in shake table, shock tester, missile testing and similar applications.



Both accelerometers are 0.75 in. high by 0.37 in. in diameter and weigh 0.1 gram. Both units use a point-loaded crystal oscillator technique which achieves resonance over sensitivity and negligible response to acceleration.

Type 4-273 measures acceleration and shock up to 10,000 g at frequencies from 7 cps to 10,000 cps. Type 4-275 measures acceleration and shock up to 5,000 g at frequencies from 2 cps to 8,000 cps.

Consolidated Electrodynamics Corp., 360 Stena Marie Villa, Pasadena, Calif.

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Typical of Lockheed's complete capability is the AGENA Satellite series. This, with its recoverable capsule, is used to gather research materials. Other satellites and spacecraft under study, under development, or in operation, include:

Sophisticated orbiting biomedical capsules - Lunar probes - Interplanetary explorer programs - A space rendezvous system - Nuclear and other advanced propulsion systems - Communications satellite systems. It is clear that the projects at Lockheed Missiles and Space Company are challenging. Moreover, its location on the beautiful San Francisco Peninsula affords precious living and perfect climate to the many rewarding opportunities available to creative engineers and scientists.

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Systems Manager for the Heavy Vehicles and the Astral Vehicle is Director Air Force Systems Engineering. Other current projects include such NASA programs as the OAO, Hubble, and Mariner planetary probes, the Mariner Venus/Mars Mariner, and the Pioneer Venus/Mars.



KAMAN K-1125, growth version of the Air Power H-41B, is powered by twin Boeing YT-40A turboshaft engines and has a redesigned cockpit, enlarged cabin and single-blade empennage. Note large amount of rubber travel available.

## Twin-Turbine K-1125 Directed to Support of Missile Sites, Special Warfare Missions

By David A. Brown

**Bloomfield, Conn.**—Kaman's K-1125, a twin-turbine, twin rotor helicopter intended also for use by Kaman Aircraft Corp., is being presented to prospective military purchasers as a machine capable of performing a variety of missions, including those associated with missile site support and special warfare requirements.

Distinguished Hadrian L (AW July 23, p. 15), the K-1125 has been developed initially with carrier funds. It is powered by two Boeing YT-40A-BDJA engines (Boeing 720 T41) and will carry 12 persons in addition to the pilot and copilot.

While retaining the basic frame and

design features of the Kaman H-41B from which it descended, the K-1125 has:

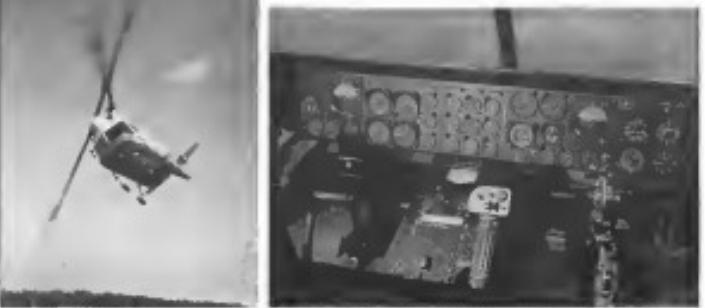
- Single-blade empennage with an anti-parallel tail which requires stability instead of trim.
- Single-rod transmission, basically the same unit as the H-41B, which is used to power both engines in a coupled and interconnected manner between the two engines.
- Internal fuel capacity increased 120 lb to a total of 130 gal.
- Improved engine controls and throttle linkage.

Kaman attempted to design a high cockpit which would be capable of performing missions in a variety of difficult environments and under different operational requirements of the various services. The result, Kaman officials stress, is a helicopter that has been designed for its particular mission and with its particular military customer in mind. The K-1125, they say, should be able to perform a variety of different missions equally well.

Despite these claims, it is obvious that Kaman is hoping to get a plug as the industry in the forthcoming strategic support helicopter competition. Although USAF has not yet stated a request for proposals, Kaman evidently believes that a twin-engine machine will be required and has based its design on this anticipated requirement.

K-1125 is able to carry 12 fully-armed troops, to convert rapidly from a personnel transport configuration, and its IFR capability also is directed toward the missile site support mission.

The other major K-1125 features are freedom from the K-1125 by Kaman. One is the driveline recovery of stabilizer or entry blade and tailfin control surfaces.



K-1125 DEMONSTRATES MANEUVERABILITY by making a tight turn at low level. Right, enlarged cockpit has flat instrument panel for IFR flight and single hand-grip throttle on collective which controls both engines. Flat windshield also is designed for IFR work.

## ENLARGED CABIN OF THE K-1125 can carry 12 fully armed troops or 1,300 lb of cargo. Rear door swings down to form loading ramp. Special VIP configuration also has been designed. Control tower at ceiling will be removed from production version.

Another feature is that capability, Kaman also sees the K-1125 as a superior rescue vehicle for the McDonnell Douglas F/A-18 Hornet fighter. And finally, the company notes that more than 600 USAF pilots and about 1,600 ground crewmen already are qualified on the H-41B.

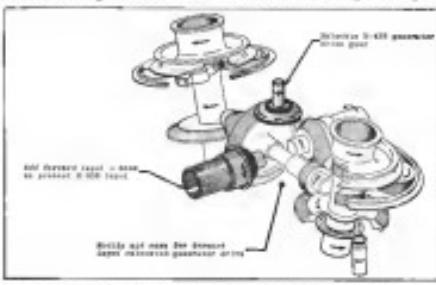
For the Army's special warfare community, Kaman has devised armament configurations which permit the helicopter to carry four forward-looking search radar-mounted infrared M475 or M480 or the NATO 762-mm Magnatrol for fire-control-mounted armament pods, as well as several canisters of smoke, which can be fired in mid-air.

Transporting capacity is designed with heavy tactical weight in mind. The K-1125 can carry standard Army 12-man medical evacuation teams or other units requiring the large, flat-bottomed seats in the cockpit's rear. Ground crews also will be able to sort through the war load in a compact group.

Again, Kaman believes that twin engines will add to the helicopter's ability to complete its mission effectively in areas where a hard landing would probably mean loss of the vehicle.

K-1125 was designed to meet Army requirements for maintenance, component availability, life-between-overhaul (LBO) and component life.

K-1125 is basically a civilian helicopter and no commercial development



HINGE CHANGES allowed H-41B transmission unit to accept power from second engine





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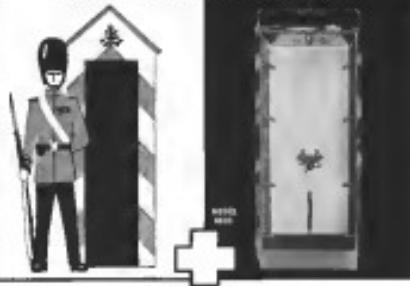
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went well depend on prior military orders. Kuman believes that commercial potential for the vehicle was around 200 orders, however. In fact, there is only one basic option designed in a positioned service by a European helicopter operator.

Final advantage Kuman believes the K-1175 possesses is in cost, both the initial price and the subsequent operating cost.

Although the airframe of the K-1175 is larger than that of the H-41B, it will not cost any more to produce it volume, according to E. J. Oshara, Kuman's senior vice president. Design refinements, principally the change from a single-engine configuration to a twin, have made the K-1175 easier and at cheap to manufacture as the H-41B.

Based on a production run of 250 air craft, the K-1175 software "won't cost a nickel more to build than the airframe of the single-engined helicopter," Oshara said.

In addition to the airframe manufacturer, 85% of the components of the dynamic system of the K-1175 are interchangeable with those of the H-41B. Other components of the K-1175 can be taken directly from the H-41B production line.

This will enable Kuman to derive the K-1175 in three configurations for approximately 10% more than it would derive a single-engine helicopter, again based on a 200 unit production run.

Key factor in the program to keep the cost of the K-1175 down was development of a single-helicopter unit which could deliver power from both engines to the main counter-rotating rotors without consuming an additional gearbox.

Transmission unit of the K-1175 is considerably smaller than that on the H-41B, from which it is derived, and after the H-41B's 54 transmission can be used on the K-1175, although the overall size is not much different.

Conversion was made by shortening the geartrain drive gear on the H-41B

### K-1125 Weight

All weather configuration	
Basic operating weight	5,351 lbs.
12 passengers	2,800 lbs.
2 pilots	400 lbs.
125 gal JP4	2,960 lbs.
Gross weight	11,171 lbs.

All weather configuration	
Basic operating weight	5,159 lbs.
12 passengers	2,600 lbs.
2 pilots	400 lbs.
125 gal JP4	2,050 lbs.
Gross weight	10,109 lbs.

Optional equipment (three cargo bins, low pass deck, emergency float tank gear and TAK) weight totals 925 lbs.





## Navy Plans Avionics Classification Change

By Philip J. Kline

Washington—Bureau of Naval Weapons' avionics division intends to identify all future avionics development programs to indicate clearly whether its primary objective is to improve reliability, performance or a combination of both.

The will be done by dividing future avionics development programs into three classes if two changes being put forth by Col. Arthur E. Lovell, chief of the avionics division, during a two-day Navy-manned man-in-the-loop conference attended by more than 500 industry and government representa-

tives. The classification assigned will depend upon the degree of importance of existing equipment and the extent to which its performance meets Navy's needs. The three categories are:

- Type I, where existing equipment performance represents 80-85% of the achievable ultimate—such as defense communication equipment—will emphasize reliability and survivability in future developments, with minimization of standardization priority areas.

- Type II, where performance of existing equipment is 50-55% of the ab-

ove minimum, will place roughly equal emphasis on improving both performance and reliability, with use of standard components whenever possible.

- Type III, where performance of existing hardware is under 50% of what is needed and achievable. Contractor will be instructed to place primary emphasis on improving performance.

Lovell said the avionics division soon will award a contract to design eight standardized power supplies whose use will be mandatory for all Type I equipment.

The avionics division has developed specifications for 83 types of standardized test instruments for use in all Type I and II equipment. This includes 17 types of basic digital functions, six in redundant operating speed ranges, 200 bits, 1 ms and 10 ms maximum speeds.

The division is working with the Electronics Industries Assn. on recommendations to obtain industry agreement on the proposed standards, Lovell said.

The division will not, however, force the use of standard components until they have undergone extensive proof testing, Lovell emphasized.

Navy officials believe the new standards will save about 500,000 different items. Lovell expressed the hope that in the future some 200 types of stand-

ard instruments could handle 95% of the Navy's avionics equipment, except for aircraft. In February 1963, Navy experts felt that there will be multiple users for most of its standard instruments, Lovell said.

Although the avionics division is placing its major emphasis on semiconductor type components (AW July 9, p. 46), Johns Hopkins University Applied Physics Laboratory, which has developed the Navy's family of antisubmarine missiles, plans to evaluate thyristor microcircuits for use in the Typhoon.

The Applied Physics Laboratory is continuing its 12-month study to determine microcircuitry to be used as a standard subsystem and experts to supervise the writer within actual circuits. The detailed analysis, 1,465 components including 225 transistors, 500 diodes, 600 resistors and 500 capacitors.

The APL flexible microcircuit specification for the Typhoon requires that all passive components be of the designated type except for capacitors larger than 0.01  $\mu$ F. Deposited components must be within 5% of design value without trimming, except for a digital/timing memory ladder in which variance must be within 0.5% of design value without using permanent APL, Stanley Godley, reported.

Godley and APL selected the thin-film approach as preferable to semiconductors microcircuitry because it was more flexible for routine design needs, required no major circuit redesign, and could be obtained more quickly. Delivery within six months was anticipated. In addition, the thin-film approach permits faster accepting speeds, "well above 1 ms," reported by the decade, Gordon said.

The Applied Physics Laboratory is likely to buy three of the thin-film designers. If their pose extensive ground training, one of the designers will be installed at flight test sites, Godley said. The parametric design can be modified easily and quickly, providing reconnection. The thin-film designer is expected to design one per quarter in each volume, and in production even greater speed, given appropriate parallel, he said. A thin-film successive digital computer designed for an undirected weapons delivery system and scheduled for delivery to the Naval Avionics Facility, Indianapolis, in mid-1963, was reported by W. N. Carroll of International Business Machines Corp. The computer, including memory, power supply, and analog/digital converters, is expected to



**The best men are often failures.**



**General Electric Opens Thin-Film Plant**

This thin-film factory, now facility opened by General Electric Light Military Electronics Dept., Utica, N.Y., has capacity for turning out 1,000 thin-film substrates a month. High vacuum facilities can deposit coatings on 20 square-inch glass substrate substrates and deposit conductors on 50 substrates at a time. Facility includes equipment for measuring dimensions of substrates and thicknesses of thin-film coats.

These thinking doesn't stop with the tried and true. They like going out on technological limb, exploring the unexplored, visiting at events where a breakthrough may be perceived by many blind alleys.

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But even if you don't find your specialty listed—don't go away. We simply don't have room to mention all the opportunities to be found throughout Northrop's several divisions. If you're the kind of man who likes to investigate new areas of technology, there's bound to be a place for you at Northrop. Write to Dr. Alexander West at Northrop Corporation, Box 1225, Beverly Hills, California, and tell us about yourself. You will receive a prompt reply.

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## Estimated Shipments of Electronic Components

Category	Quantity		Value	
	Units	Thousands of units	Units	Thousands of dollars
Experiments	Units	100,000	Time	100,000
Computer Components	Units	11,540	Units	11,400
Computers	Units	20,000	Units	14,200
Memory Devices	Units	2,152	Units	1,700
Logic and Interface Circuits	Units	2,000	Units	1,100
Transistors	Units	100,000	Units	100,000
Thyristors and Diodes	Units	11,000	Units	1,000
Integrated Circuits	Units	2,200	Units	1,000
Resistors	Units	99,334	Units	16,200
Capacitors	Units	5,000	Units	4,000
Inductors	Units	100,000	Units	100,000
Total		300,000		80,000
Source:				100,000

\* Millions of \$; prices taken for million quantities are used, and are rounded off to nearest \$100.

weight 11-lb. In and occupy a volume of 0.4 cu. ft., Carroll said.

The computer will be a general purpose synchronous machine, designed for parallel operation, using a 36-bit data word and a 13-bit address word. The ferrite core memory will have a storage capacity of 1,024 words. Computer will operate at a 100 kc clock rate.

A semi-autonomous thinnable microcircuit production facility, capable of fabricating nearly 1,000 31 x 51 x 50-micron cells per hr., is now in use by International Business Machines Corp., F. L. State of IBM reported. A smaller thinnable production facility recently has been delivered by IBM to the North Avenue Facility, Indianapolis.



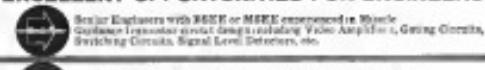
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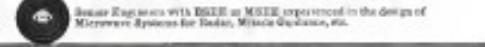
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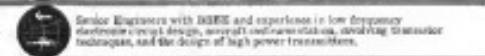
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Tests are getting under way to evaluate the vulnerability of thin-film microcircuits to transient and permanent radiation damage using both a nuclear reactor and a linear accelerator. J. M. Lee, Bell-Wupe Advanced Technology Branch reported. Plans call for side-by-side comparisons to evaluate the relative vulnerability of thinnable and unthinnable types of microcircuits. Lee said the Navy hopes to have complete data within six to eight months.

► **Filter Center**  
**■ Ultraviolet Laser Award**—Air Force's Space Systems Division will soon contract with Space Technology Laboratories for theoretical investigation of lasers operating in the ultraviolet region of the spectrum. Award is based on an unclassified STL proposal.

► **NASA to Fund Three-Plus Solar Cell Activities**—Two separate approaches to achieving longer lived lightweight thin-film solar cells will be investigated by National Aeronautics and Space Administration during the current fiscal year. One of these efforts will be with the poly-crystalline-silicon solar cell program at Hughes Aircraft Co. (AWM July 31, 1961, p. 62, Oct. 17, 1961, p.

► "Clear" Signals for Communications—Pulse compression techniques used in pulse-to-absence signals, known as "clear," yield because of their non-coherence to the sound made by a bird, offer attractive advantages for use in digital communications, Mischa R. Winkler of Radio Corp. of America reported at Wescos. Winkler said that clear technique is less affected by Doppler shift than conventional frequency shift keying, is less affected by noise and natural interference and can be used with existing voice communication channels. A disadvantage is that it requires wide bandwidth signals.

► **Laptops** Computer for Boot-Glitch-Sentry Prototype is being developed by USAF's Astronautics System Division to design and build an on-board laptop computer for use in "advanced boot-glide vehicles," presumably the Dyna-Sat (X-20), as a follow-on program.

► **New Thin-Film Insulator Report**—New technique for insulating or treating thin, surface layers of semiconductors with solid surfaces has been developed by International Business Machines Corp. at Watson Research Center. Techniques involve polarization of boron-doped, an oxygen gas, into a solid coating layer by bombarding the gas with an electron beam.



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**A radiation effects physicist, to do research with emphasis on solid state devices. A flight test engineer, who can conceive programs, estimate manpower requirements and costs.**

**A reliability engineer, to perform reliability analysis of space systems and subsystems in proposal and development phases.**

**Structural analysts, to develop fresh analytical techniques and apply them to new space structural concepts, to do stress analysis and design substantiation studies on advanced space vehicle structures.**

**A plasma physicist, to join our growing program in the measurement of plasma properties, spectroscopic diagnostics, accelerators and power conversion devices.**

**A materials engineer, to concentrate on systems analysis and operations analysis applied to military and non-military space systems.**

**Programmers experienced in electro optical imaging devices and laser theory, engineers mathematicians interested in detection theory, measurement and tracking, electronic engineers who know their way around statistical communications theory and noise phenomena. You're new and original work in satellite detection systems.**

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*Of interest to engineers and scientists*



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# BUSINESS FLYING

## General Aviation Told Of Financing Sources

Milville, N.J.—Peter Etteman management and finance to explore fully the potential business aircraft market are holding back from early site of the general aviation industry, aviation business were told at the recent Avwest Corp. symposium here.

Financial problems confronting the industry were outlined by Donald S. Bilezikian, executive director of National Aviation Trade Assn., who called for application of the basic rules of finance and accessibility by other private business.

Henry Ryan, vice-president manager for Beech Aircraft Corp., presented the owner-pilot, noting that studies have shown that he has less than 10% participation of the potential general aviation market.

Ponting to the expand trend in aircraft and operating costs, Bilezikian said general aviation has long neglected its financial base, but that is true the industry instead. The challenge, he said, is to follow the example of other industries in exchanging maturing and financing information so that individual operators can stay ahead of industry-wide developments.

A sort of the parts approach is necessary to win a \$4-billion business, Bilezikian said.

Bilezikian listed five principal sources of financing for the aviation businesses, suggesting how some could be more fully exploited.

• Banks—In the past, bankers have done well to understand the financial needs of the industry, but many could be made to understand the importance of business aviation were explained to them.

• Private investors—General aviation users are some of the best sources. Many feasible options, for example, could arise from financial institutions by approaching them over carefully.

• Venture capital—Investor satisfaction in a source of money required to meet company, but again, a major effort must be made to tell the aviation story to outside investors.

• Stock issues—Because of the time and effort involved, stock issues should be reserved primarily for major financing needs. More aviation businesses should explore the form of their states, however, to determine if they allow simplified stock issues on an infinite basis.

• Small business investment companies.

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**Propulsion.** Man, seek knowledge of the fundamental techniques to do research and development on solid, liquid, hybrid, and air-breathing systems.

**Vehicle dynamics and control.** For research and development in aerodynamics and flight control, particularly as applied to VSTOL vehicles, space launch aircraft, and six-degree-of-freedom near earth trajectory problems.

**Electromagnetic.** For studies in energy propagation and field theory pertinent to such areas as communications, electron, radar, cross sections, and plasma sheets.

**Fluid mechanics.** For analysis of subscale, supersonic and hypersonic flows.

**Communications.** To produce analysis and integration of new concepts in telemetry, command, detection, and tracking systems.

**Experimental aerodynamics.** To work with a group that will support theoretical aerodynamics, numerical approaches and will initiate experimental research to fit solids in the theoretical framework.

**Operations research.** To evaluate complete weapons systems, and apply basic knowledge to new and diversified problems.

**Business and controls.** To conduct study and analysis of sensors and computers.

**Systems research.** To work on systems performance optimization.

**Material analysis.** To develop large-scale numerical procedures for aerodynamic design and flow-field analysis.

**Avionics.** To work on the design, development and analysis of avionics systems for aerospace applications.

**Reliability.** To assess the reliability and optimize the configurations and mission profiles of aerospace systems.

**Climatic research.** To work on the development and application of structural adhesives for aerospace vehicles.

**Metallurgical research.** For research and development on materials and joining.

If you'd like more information about these opportunities and others that may be available in the area you need them, write and tell us about yourself. Contact Ray L. Pool, Engineering Center Personnel Office, 3001 West Broadway, Hawthorne, California.

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**News—Federal Aviation Agency is considering a joint program with the Small Business Administration to provide assistance to general aviation operators.**

Bilbino said more general aviation operators also fail to use them, often preferring ones they have acquired. The most important thing is to ensure a return on investment by good business practices, such as cash flow planning, use of standardised accounting practices and long-term budgeting.

Central auction operation cannot  
grid their good business practices,  
Bibbosa said. And at long as they do, they  
will continue to depress the industry,  
instead of encouraging it growth.

In presenting his market proposal,  
Bibbosa outlined the procedure and to  
determine the number of potential geo-  
calisation customers. He started with  
the total number of business firms in  
the U.S., approximately 5.5 million,  
and eliminated 1.5 million which he de-  
termined had neither the need nor the  
money for a business aircraft. Of the  
other one million, 120,000 had the need  
but not the money, Bibbosa said.

Remaining 790,000 passengers with both the need and the money represent the potential market, according to Rynes. They were further qualified in the type of aircraft required for their operation. Of the total, 150,000 are in the single-engine class and 60,000 in the twin-engine class. An encamping 100,000 were listed as a separate category, ranging from the heavy single to the light, four-passenger class.

Business fleet of about 40,000 aircraft represents a less than 30% penetration of this potential market. Some and, because many firms have flown off aircraft. The city, compared with that of other countries, is very poor. In total

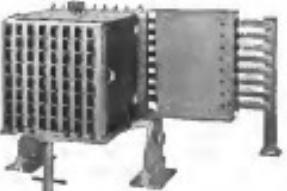
Further, 79% of new aircraft sales are to individuals and companies of small enough size to own aircraft having a low number of passengers and per

Risks and the range both of general aviation aircraft and growing operating costs are not significant factors in designing new aircraft. The performance of modern single-engine landplane compares with that of those World War I fighters.

Communication systems provided for them have increased capability, and airframe design and construction techniques are constantly improving. All these factors permit more infiltration per year and actually give the user a higher

return on his investment, Raus noted. Once general aviation has given the customer what he wants at a price he is willing to pay, the market will continue to expand at a steady rate, Raus said. If that rate is to be accelerated, however, an effort must be made to tap the large potential market group of non-users and non-owners, he added.

Opportunities in Basic Research or Development in the fields of  
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**■ Requirements of new and continuing projects concerned with space vehicle command, navigation, and relay have created unique requirements for aerodynamicists as well as avionics engineers. The scientists and engineers of the Research and Development Division of the Hughes Aircraft Company Antennas Division in Culver City are possessing broad scientific and technical leadership in government and commercial applications of advanced electronic and space communication systems, as well as in the development of advanced communications and navigation systems.**

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## LETTERS

### Slow Reaction

After reading the CAA Aircraft Inquiry Report (Aviation Week, Aug. 6, 1973), concerning the TWA 727B-40T engine failure, with considerable interest in the legal profession's investigation phase and the usual factless compilation of data, certain elements in the conclusion, I find, appear somewhat questionable.

For all let me state that the probable cause cannot be faulted and it certainly the product of one of the most competent aviation investigations ever made. However, let's review some aspects here and hope you will agree.

The flight crew of Allstate, New York (approximately 1500), a control explosion left and hand by the crew and the aircraft commenced a dive to the left. The cockpit was immediately disengaged and the aircraft was brought back to a normal flying attitude. The flight engineer then advised that cabin pressure had dropped. Thereupon, the crew went on emergency oxygen and activated the out box sets.

All Traffic Control was discontinued and the flight was deemed to descend to and remain 1000 feet above ground level.

To my knowledge at the time the older hydraulic system and the No. 1 generator had failed. The No. 1 engine was then shut down.

The rate of the explosive decompression descended to the rate of the catastrophic failure of the aircraft. For many hours prior to this time the engine had been powerfully running—very likely at the maximum specified in the engineering analysis of the report. After some two dozen or so seconds of explosive combustion and maintenance and fire it is believed that propagation to the outer skin of the aircraft which came were noted prior to the explosion and that, at least by the published decom-

*Aviation Week endorses the opinions of its readers on the issues raised on the magazine's editorial columns. Address letters to the editor, Aviation Week, 1300 Broadway, New York 10018. Try to keep letters under 300 words and give a genuine identification. We will not print anonymous letters, and names of writers will be withheld on request.*

ing of even lateral separation spaces must adjust to the known fact that things have to be accomplished quickly as in even more problematic manner than looks at the prop—police you can't use problem guys in interviews.

It does not reflect to be valid on the subjet, but it occurs to me that most of the info I stated living with readily for years are not about the reasons related to this case one way or another. The Air Force has given me standard form to submit and review for the CAA. I would like to add that the CAA is making changes requirements as the jet age and applies new experience in accident analysis relating to the human factor.

WILLIAM C. REED  
Major, USAF  
Flight Test Maintenance Officer

### 70 Landing Charges

The compromise resolution for separating two Boeing 707 landing charges on p. 115 of your Sept. 10 issue is unsatisfactory, but can also be argued. The resolution is off the mark for which the board is. It is agreed from the writer's test that the landing fees per precipitation do support terminal fee rates necessary for next seasons.

Such is not the case at Tokyo International Airport and the two other airports using landing charges at present and operated by a private company. Its revenues are not only related to the physical operations of the airport, under the administration of the Japan Civil Aviation Bureau. Public is not passed on to the airport for operating necessary areas and by its nature related to the revenues needed and allocated to the funding of public use.

Actually, landing fees increased approximately 3% in Mar., 1968, and on new S\$2.33 plus an additional \$0.95 for night landings. The total revenue per landing decreased to \$17.60, plus \$3.13 for night landings and after 300 landings, to \$17.10 and \$4.17.

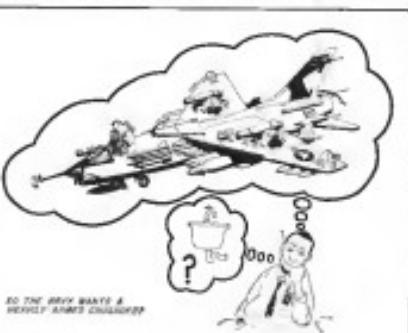
We trust the explanation will clear up a possible misconception about the landing fees and who pays them in Japan.

Carsten H. Ellerbeck  
Secretary  
Airport Operations' Committee  
Tokyo International Airport

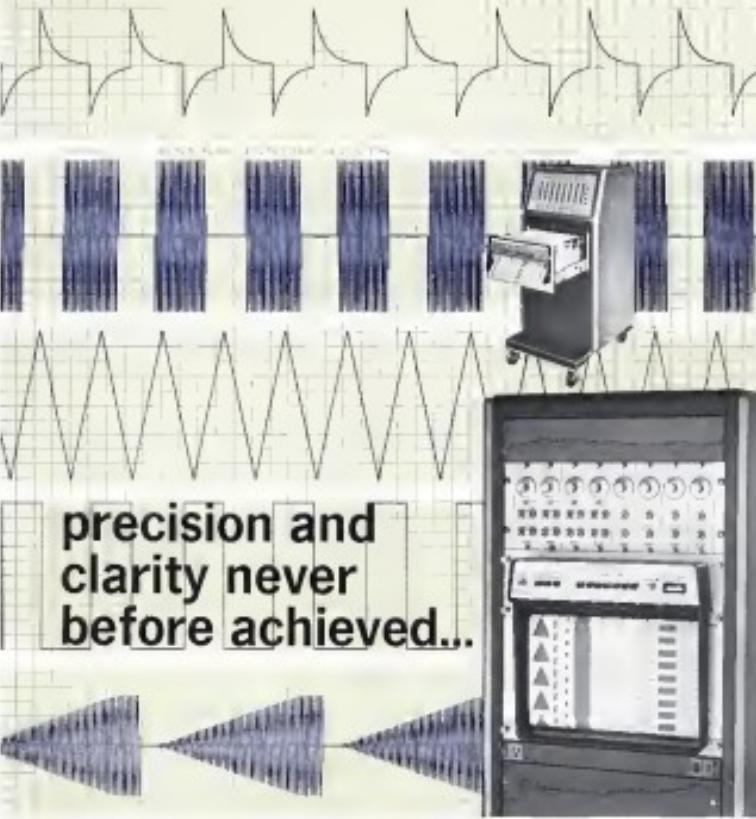
### Early Issues

The experts have little value in a space program. I believe that a group of men rather than scholars that can do one of the oldest continuously published aviation magazines in the world and I like to think that experts I would like to know if any of your readers have early issues that they would consider selling—some perhaps that are just taking up space or in gauge space. I hope to receive to have one copy of every issue from 1956 to date.

DENNIS D. JONES  
121 Baldwin Ave.  
DeKalb, Wis.



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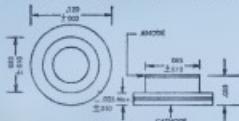
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